Smart Farm Chain: AI-Driven Precision Farming Using Drone Vision, Iot and Blockchain

Nichit Vaishnavi[1], Thube Avantika[2], Tikone Anjali[3] , Prof. Bangar Sonika [4]
Samarth College of Engineering and Management Belhe

***Abstract*—Agriculture is facing unprecedented challenges such as climate change, resource scarcity, crop diseases and inefficient supply chain management. To address these issues, this project proposes Smart Farm Chain: AI-Driven Precision Farming Using Drone Vision, IoT and Blockchain, an integrated smart farming framework that leverages advanced technologies to optimize agricultural productivity and sustainability.**

The system uses AI-powered drones for aerial crop monitoring, disease detection and yield prediction, while IoT-based sensors continuously track environmental and soil parameters such as temperature, humidity and moisture levels. The collected data is processed using machine learning algorithms to provide farmers with actionable insights for precise irrigation, fertilization and pest control. To ensure transparency and trust, harvested produce and supply chain transactions are recorded on a blockchain network, enabling traceability from farm to consumer and eliminating fraudulent practices.

By combining AI, IoT and blockchain technologies, Smart Farm Chain creates a data-driven, sustainable and transparent agricultural ecosystem. It not only increases crop yields and resource efficiency, but also ensures fair market access and food security, contributing to the advancement of precision agriculture and sustainable agriculture.

***Index Terms*—Smart agriculture, precision farming, machine learning, unmanned aerial vehicles, artificial intelligence.**

I. INTRODUCTION

Agriculture has always been the backbone of human civilization, but traditional farming methods often suffer from inefficiencies, unpredictable yields, and lack of transparency in the supply chain. With the growing global population and rising food demand, there is an urgent need to adopt smart and sustainable farming practices.

SMART FARM CHAIN: AI-Driven Precision Farming using Drone Vision, IoT, and Blockchain is an innovative approach that integrates cutting-edge technologies to revolutionize modern agriculture. By leveraging AI-powered drone vision, farmers can monitor crop health, detect pests, assess soil conditions, and optimize irrigation with high accuracy. IoT-enabled sensors provide real-time data on temperature, humidity, soil moisture, and nutrient levels, ensuring resource-efficient farming practices. Furthermore, blockchain technology ensures secure, transparent, and tamper-proof supply chain management—connecting farmers, distributors, and consumers with trust and accountability.

This project aims to maximize productivity, reduce resource wastage, and improve sustainability in agriculture while ensuring transparency across the entire food supply chain. By combining AI, IoT, drones, and blockchain, SMART FARM CHAIN creates a comprehensive ecosystem for precision farming, leading towards a smarter, greener, and more resilient future for agriculture.

II. LITERATURE SURVEY

A brief overview of existing work in various papers, which have been referred for implementation:

In [1] 2024, Ghulam Mohyuddin1, Muhammad Adnan Khan, Evaluation of Machine Learning Approaches for Precision Farming in Smart Agriculture System: A Comprehensive Review, In the era of digital data proliferation, agriculture stands on the cusp of a transformative revolution driven by Machine Learning (ML). This study delves into the intricate interplay between Information.

In [2] 2023, Abhinav Sharma, Arpit Jain, Prateek Gupta, Machine Learning Applications for Precision Agriculture: A Comprehensive Review Agriculture plays a vital role in the economic growth of any

country. With the increase of population, frequent changes in climatic conditions and limited resources, it becomes a challenging task to fulfil the food requirement of the present population.

In [3] 2023, Ersin Elbasi, Nour Mostafa Artificial Intelligence Technology in the Agricultural Sector: A Systematic Literature Review, AI is emerging in three major categories in agriculture, namely soil and crop monitoring, predictive analytics, and agricultural robotics.

III. EXISTING SYSTEM

The existing farming system is largely based on traditional practices where most farmers still rely on manual methods for crop monitoring, irrigation, and pest control. This approach results in low efficiency, delayed decision-making, and a higher risk of crop failure. Although some farmers use basic technologies such as weather forecasting tools or simple irrigation systems, these are not integrated with advanced technologies like Artificial Intelligence (AI) or the Internet of Things (IoT), making them less effective for precision farming. Crop health and disease detection are mostly carried out through visual inspection, which is time-consuming, prone to human errors, and often leads to late detection of problems. Additionally, the management of resources such as water, fertilizers, and pesticides is inefficient, as these inputs are often used without proper measurement, causing wastage, soil degradation, and reduced crop quality. Furthermore, the agricultural supply chain lacks transparency and traceability, preventing consumers from verifying the authenticity and quality of products, while farmers struggle to receive fair prices for their produce.

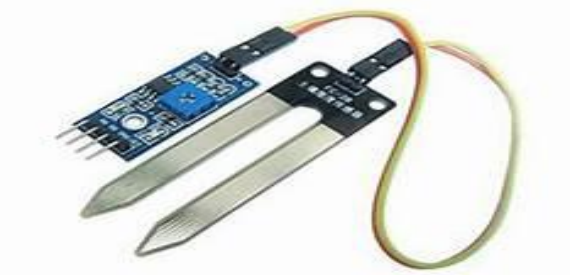
IV. PROPOSED SYSTEM

The proposed system introduces an intelligent and technology-driven approach to modern agriculture by integrating Artificial Intelligence (AI), the Internet of Things (IoT), and Blockchain technologies. It utilizes AI-powered drones equipped with computer vision to capture aerial images of farmlands, enabling real-time monitoring of crop health, early detection of diseases, and accurate yield estimation. IoT-based smart farming is implemented by deploying sensors across the fields to continuously collect data on soil moisture, temperature, humidity, and nutrient levels, thereby supporting precise and informed farming decisions. The collected data is analyzed using machine learning algorithms to provide farmers with actionable insights for efficient irrigation, fertilization, and pest control. Through precision resource management, the system ensures optimal utilization of water, fertilizers, and pesticides, minimizing wastage and reducing environmental impact. Furthermore, a blockchain-enabled supply chain is integrated to securely record agricultural transactions and product movements, ensuring transparency, security, and tamper-proof traceability from farm to consumer. This farm-to-consumer traceability allows consumers to verify the origin, quality, and authenticity of agricultural products, fostering trust, promoting fair trade, and empowering farmers in the agricultural ecosystem.

4.1 DRONE

A drone, also known as an Unmanned Aerial Vehicle (UAV), is an aircraft that operates without a human pilot onboard and is controlled either remotely or autonomously using software-controlled flight plans. In agriculture, drones are equipped with cameras, sensors, and AI technology to capture aerial images for crop monitoring, pest detection, soil analysis, and yield estimation.

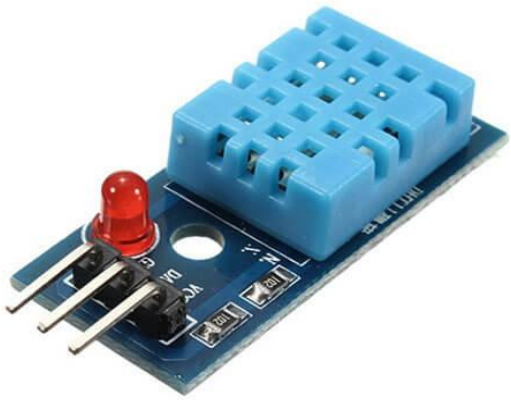
4.2 SOIL MOISTURE SENSOR



This is a Soil Moisture Sensor, used to measure the water content in the soil. It consists of two probes that

detect moisture levels by measuring electrical resistance. The sensor helps in efficient irrigation by indicating when the soil is dry and needs watering.

4.3 TEMPERATURE & HUMIDITY SENSOR



A Temperature and Humidity Sensor measures the surrounding air's temperature and moisture levels. It helps monitor environmental conditions in agriculture, ensuring crops grow under optimal climate conditions. Common examples include the DHT11 and DHT22 sensors.

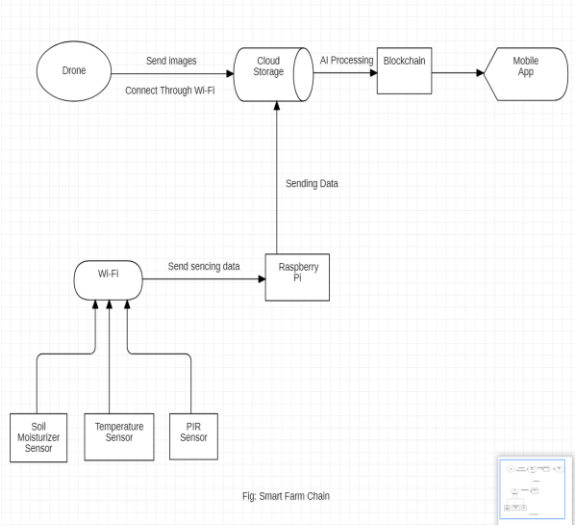
4.4 PIR SENSOR

A PIR (Passive Infrared) Sensor detects motion by sensing infrared radiation emitted by objects, typically humans or animals. It is commonly used in security systems, smart farming, and automation to detect movement within a specific area.

4.5 RASPBERRY PI

The Raspberry Pi is a small, affordable, single-board computer used for learning, development, and automation projects. It can run various operating systems like Linux and is equipped with USB ports, GPIO pins, and wireless connectivity, making it ideal for IoT, robotics, and smart farming applications.

V. SYSTEM ARCHITECTURE



The Smart Farm Chain diagram shows how IoT, AI, and blockchain work together for smart farming. Drones capture farm images and send them via Wi-Fi to cloud storage, while sensors (soil moisture, temperature, PIR) send data through Raspberry Pi to the same cloud. AI processes this data to generate insights, which are stored securely on the blockchain. Farmers can then access real-time updates and recommendations through a mobile app, enabling efficient and transparent farm management.

VI. CONCLUSION

The project "SMART FARM CHAIN: AI-Driven Precision Farming using Drone Vision, IoT, and Blockchain" presents an innovative approach to transform traditional agriculture into a smart, data-driven, and transparent system. By integrating AI-powered drone vision for real-time monitoring, IoT sensors for environmental data collection, and blockchain technology for secure supply chain management, the system addresses critical challenges such as low productivity, resource wastage, and lack of transparency. The proposed solution not only helps farmers increase yield, reduce costs, and adopt sustainable practices, but also ensures traceability and trust for consumers. Moreover, the project creates a technology-enabled ecosystem that empowers farmers, promotes fair trade, and supports long-term agricultural sustainability.

REFERENCES

[1] M. A. Khan, A. M. Saleh, M. Waseem, and I. A. Sajjad, ''Artificial intelligence enabled demand response: Prospects and challenges in smart grid environment,'' IEEE Access, vol. 11, pp. 1477–1505, 2023.

[2] E. Vrochidou, C. Bazinas, M. Manios, G. A. Papakostas, T. P. Pachidis, and V. G. Kaburlasos, ''Machine vision for ripeness estimation in viticulture automation,'' Horticulturae, vol. 7, no. 9, p. 282, Sep. 2021.

[3] D. Elavarasan, D. R. Vincent, V. Sharma, A. Y. Zomaya, and K. Srinivasan, ''Forecasting yield by integrating agrarian factors and machine learning models: A survey,'' Comput. Electron. Agricult., vol. 155, pp. 257–282, Dec. 2018.

[4] V. Bhatnagar and R. Chandra, ''IoT-based soil health monitoring and recommendation system,'' in Internet of Things and Analytics for Agriculture, vol. 2, 2020

[5] C. F. Gaitán, "Machine learning applications for agricultural impacts under extreme events," in Climate Extremes and Their Implications for Impact and Risk Assessment, Elsevier, 2020

[6] R. K. Singh, A. Kumar, and P. Sharma, "Smart Farming: Securing Farmers Using Blockchain Technology and IoT," Procedia Computer Science, vol. 167, pp. 2091–2100, 2020.

[7] S. P. Singh and M. Sharma, "Blockchain-Based Smart Farm Security Framework for the Internet of Things," Sensors, vol. 23, no. 18, pp. 7992, 2023.

[8] M. Wolfert, L. Ge, C. Verdouw, and M.-J. Bogaardt, "A Systematic Review of IoT Solutions for Smart Farming," Computers and Electronics in Agriculture, vol. 151, pp. 125–139, 2018.

[9] F. Tian, "Blockchain and Smart Contracts Based Agricultural Supply Chain Management," Procedia Computer Science, vol. 134, pp. 155–162, 2018.

[10] P. Kamilaris, A. Fonts, and F. X. Prenafeta-Boldú, "Blockchain Technology in Agriculture: Enhancing Supply Chain Transparency and Traceability," Future Generation Computer Systems, vol. 107, pp. 634–649, 2020.

[11] J. Li, Y. Zhang, and H. Wang, "Intelligent Decision-Making Framework for Agriculture Supply Chain Visibility," Computers and Electronics in Agriculture, vol. 205, pp. 107–122, 2024.

[12] M. Žagar, T. Novak, and S. Kovačič, "Study on Collaborative Smart Farming Over Digital Platform," International Journal of Advanced Computer Science and Applications, vol. 15, no. 2, pp. 45–54, 2024.

[13] Tandon and R. Gupta, "Automated Supply Chain Management in Agriculture Using Blockchain and IoT," Journal of Food Quality and Hazards Control, vol. 10, no. 3, pp. 145–156, 2023.

[14] A. Tandon and R. Gupta, "Automated supply chain management in agriculture using blockchain and IoT," Journal of Food Quality and Hazards Control, vol. 10, no. 3, pp. 145–156, 2023.

[15] A. A. Aliyu, M. A. H. A. Bakar, and M. S. M. Ariffin, "Blockchain-based smart farm security framework for the Internet of Things," Sensors, vol. 23, no. 18, pp. 7992, 2023.

[16] S. P. Singh and M. Sharma, "Blockchain-based smart farm security framework for the Internet of Things," Sensors, vol. 23, no. 18, pp. 7992, 2023.

[17] M. Wolfert, L. Ge, C. Verdouw, and M.-J. Bogaardt, "A systematic review of IoT solutions for smart farming," Computers and Electronics in Agriculture, vol. 151, pp. 125–139, 2018.

[18] P. Kamilaris, A. Fonts, and F. X. Prenafeta-Boldú, "Blockchain technology in agriculture:

Enhancing supply chain transparency and traceability," Future Generation Computer Systems, vol. 107, pp. 634–649, 2020.

[19] J. Li, Y. Zhang, and H. Wang, "Intelligent decision-making framework for agriculture supply chain visibility," Computers and Electronics in Agriculture, vol. 205, pp. 107–122, 2024.

[20] A. Morchid, "Blockchain and IoT technologies in smart farming to enhance transparency and sustainability," Procedia Computer Science, vol. 171, pp. 1423–1430, 2025.