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Farmer Hub: A Holistic Digital Platform for Crop Health, Market Access, and Land Leasing.

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Improving agricultural productivity and support farmers with better decision-making tools has become increasingly significant in modern farming. However, Farmers still face several challenges such as delayed detection of crop diseases, inefficient use of resources, limited access to expert guidance and weak market connectivity which in turn affect their income levels. Though various digital farming tools are available in the market, most of them offer solutions to only a limited number of issues and not a comprehensive solution to farmers' problems. In this study, a smart agriculture platform is proposed that incorporates various important features such as crop disease detection, expert advice, real-time environmental monitoring, farmer interaction, and market connectivity in a single platform. The proposed system uses image analysis techniques to detect crop diseases at an early stage by analyzing the leaves of plants and get real-time weather data for better decision-making by farmers. The platform uses image analysis of the leaves of the plants to diagnose the diseases at an early stage. In addition, it uses real-time weather and sensor data to improve decision- making. The proposed platform is a web-based system, making it easy to ensure the smooth running of the system. The results of the proposed system indicate improved accuracy in the diagnosis of the disease, improved response time in cases of crop-related issues, improved accessibility of expert advice, and transparency in the conduct of business in the market. The proposed system improves the efficiency of the farming sector, which is currently inefficient in the case of traditional and partially digital farming.

Keywords— Artificial Intelligence, Market Connectivity, Crop Disease Prediction, and Smart Agriculture

II. Introduction

Another sector that is witnessing a major transformation is the agricultural sector, which is being transformed through the injection of Artificial Intelligence (AI) and Internet of Things (IoT) sensors, as well as real-time environmental analyses. For instance, this technology is essential in boosting the productivity of the global food demand, which is ever increasing as each day passes. Nonetheless, the sector still experiences some long-standing challenges that adversely affect the financial flows of farmers, including unforeseen climatic changes, degraded soils, attacks from pests, late diagnoses of diseases, the absence of urgent expert consultations, and the unavailability of reliable market information. It is apparent that despite the research indicating the effectiveness of real-time analyses using the Internet of Things and deep learning-based crop disease diagnostics, most existing approaches are confined to discrete features and incapable of providing an intelligent decision support system. It results in an enormous research requirement in designing an integrated and accessible intelligent agriculture system capable of helping farmers with disease management, resource utilization, collaboration, and market linkage. Therefore, with an aim of boosting productivity, sustainability, and resilience in the agriculture sector, this research work aims at developing an AI-assisted precision agriculture system incorporating intelligent crop disease detection, data analytics, knowledge sharing, advisory services, and market linkage between farmers.

III. PROBLEM STATEMENT

To ensure smooth and intelligent farming processes, the proposed AI-enabled smart agriculture system employs a modular system architecture that amalgamates a React.js frontend, a FastAPI back-end, AI inference models, and a real-time cloud database powered by Supabase. The CNN models designed for image analysis to identify plant diseases, RNN/LSTM models, and attention-based predictive analytics techniques to forecast market prices, among others, are just a few examples of the advanced deep learning techniques employed by the system. To improve the robustness and versatility of the models, the smart agriculture system employs a range of datasets, which may encompass images of crops, soil data, meteorological variables, and market information obtained from numerous sources. Preprocessing pipelines in OpenCV and Python are used for all data received, aiming to ensure the quality of input data for the execution of the models, such as denoising, scaling, normalization of brightness, feature extraction, and validation. The system guarantees the safe storage of data, real-time synchronization, as well as the communication of users with the backend services. The proposed system was implemented using Python, TensorFlow, PyTorch, FastAPI, React.js, and Supabase. The proposed architecture enables the accurate diagnosis of diseases in crops, the intelligent support of decision-making, the effective connectivity of the market, as well as the development of digital cooperation, thus promoting the user experience, productivity, and sustainability in modern agriculture.

IV. OBJECTIVES

The main purpose of the AI-Based Smart Agriculture Platform is to develop an efficient and accessible system to assist farmers with the management of agricultural activities with the use of intelligent technology. The early diagnosis of diseases affecting plants and the treatment of the same are facilitated by the AI-Based Smart Agriculture Platform, which enables farmers to upload images of crops to obtain results of AI-based crop disease detection. The platform also provides advisory services to farmers to ask for advice on how to improve the management of crops. Through farmer-farmer interaction and collaboration, whereby users are able to share farming-related information, expertise, and best practices, the system enhances the operations of farming activities. The system also has a digital marketplace whereby farmers are able to link with large buyers directly, ensuring that they are able to get reasonable prices for their produce without the need to deal with middlemen. The system also has an investor-farmer land leasing module, which enhances productivity in farming activities through the effective utilization of unused land.

V. METHODOLOGY

For ensuring that it is effectively operational and meets the needs of farmers, agricultural experts, buyers, and investors, the AI-Based Smart Agriculture Platform is under development in a structured manner. The web-based application of the system is connected through a digital platform, which is a centralized platform. A reliable and flexible system that can support smart farming is created using advanced web technologies, which include Supabase (PostgreSQL) database management, FastAPI, and React.js. When a user registers and logs in to the program, it begins to function. The farmer can upload pictures of their crop leaves to diagnose diseases.

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Using the AI-based crop disease detection algorithm, the system will analyze the photos uploaded by the farmers to detect the potential health problems of the crops, their remedies, and so on. After that, the results will be stored in the database, showing the results to the farmers through their dashboard, so that they can keep track of the health of their crops and take preventive measures accordingly.

By asking questions through the site, farmers will be able to get expert advice regarding the management of crops, methods of farming, and so on. Through the cooperation section, farmers will be able to communicate with each other, share their methods of farming, their experiences, and solutions to the problems faced during agriculture. In order to enhance the transparency of the prices of the products and reduce the involvement of middlemen, the farmers can list their products and sell them to the large customers through the digital marketplace module provided by the system. In order to make maximum use of the land and increase the productivity of the land, the investors can lease the land to the farmers through the investor-farmer land leasing module.

The administrative dashboard provides a facility to store all the activities of the system, such as the results of the crop analysis, discussions on the advisory services, the transactions of the digital marketplace, and the land leasing agreements.

VI. SYSTEM ARCHITECTURE

1. User Interface (React.js Frontend)

Using React js, the platform offers a modern one-page design that makes the communication easy among Farmers, Experts and the Customers. It oversees:

- Upload the image of the diseased crop image from the gallery, which is accomplished by the validation response.
- Real time crop scanning and it also generates the report.
- Navigation of modules: Market, Community, Expert Consultation, Requests and other modules.
- Authentication token is done using JWT for safe connection with an API.

The interface focuses on accessibility to the rural population because the language support and UI components are provided.

2. Data Capture & Preprocessing Layer (FastAPI + Edge Processing)

- It receives user inputs such as location, type of crops, soil variables, and leaf photos from users.
- Image scaling, light normalization, and denoising
- Formatting soil and environmental data into a structure appropriate to modelling

These processes play an important part in ensuring that the forecasts made by the model.

3. Advisory, Collaboration & System of Expert Advice

Users use internet forms to request professional advice.

- Experts respond via scheduled appointments or chat.
- A RESTful API handles consultation logs and requests
- Farmers' data is used to personalize recommendations.
- Knowledge Sharing & Farmer Community
- Peer-to-peer forum- seek advice, gain insight, and solve problems.
- Sharing resources involved the use of equipment, fertilizer, and seeds. • Consumer and Marketplace Connection • Farmers post prices for fresh produce.
- Customers place purchase orders with the information on delivery.

Together, such services make the process of learning much easier and increase earnings as well as the ability to work together.

4. Backend Infrastructure & Data Store (Supabase)

The data stored is composed of:

- Users (buyer, farmer, and expert profiles)
- History of crop disease scans and treatment records
- Tracking of deliveries and market transactions
- It now becomes possible to Consultation by experts & conversation records

2. Features Provided:

- UI updates through instant synchronization
- Role-Based Access Control for Secure Storage • Developing reports with speed using indexed queries

3. Data dashboards help in the following:

- Regular cases by region
- Market trends in demand as the market
- Efficiency in Farmer Connections & Expert Service

5. Farmer-to-Farmer Collaboration Module

Digital engagement enhances information dissemination and the empowerment of the agricultural communities. It allows:

- Sharing knowledge in irrigation practices, soil improvement, and preventive measures against diseases
- Trade involving farm resources, such as seed, fertilizer, and farm tools
- Tagged conversation threads for enhanced content discovery
- Establishing local networks for supporting group decision-making sessions
- Quick notifications for local weather threats or pest infestations

Having valid and trustworthy peer advice is made possible by a rating system. In order to develop self-supporting digital agriculture, the community will be strengthened through this module. 6. **Farmer-to-Bulk Buyers Marketplace**

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By eliminating the need for middlemen, this module promotes a clean commerce ecosystem.
Key process:

- Produce price, quantity, date of harvesting, and location where harvested - all these details are provided by farmers.
- Customers engage in the negotiation of prices and the making of mass requests.
- Order tracking with status updates on deliveries
- Integration of digital payment options and safe invoice management

Analysis of demand for the determination of the best pricing times for farming Demand Analysis
7. Investor Support & Land Leasing Module
It is intended to connect urban cultivators and farmers with investors.
It offers support for:

- Proposals related to leasing non-owned or urban land
- Investment opportunities in high yielding agricultural ventures
- Evaluations of Project Viability Driven by Predictive Analytics
- Agreements on profit-sharing set by the platform
- Verification and openness in farmer and investor alliances

Module Description (Expanded)
1. Dashboard page
The different modules comprising crop disease detection, farmer collaboration, expert consultation, investment access, and smart supply chain management are tested with realtime data. Further, the system's predictions, user interactions, and decision-support outputs were studied to evaluate its efficacy for enhancement in agricultural productivity and sustainability.

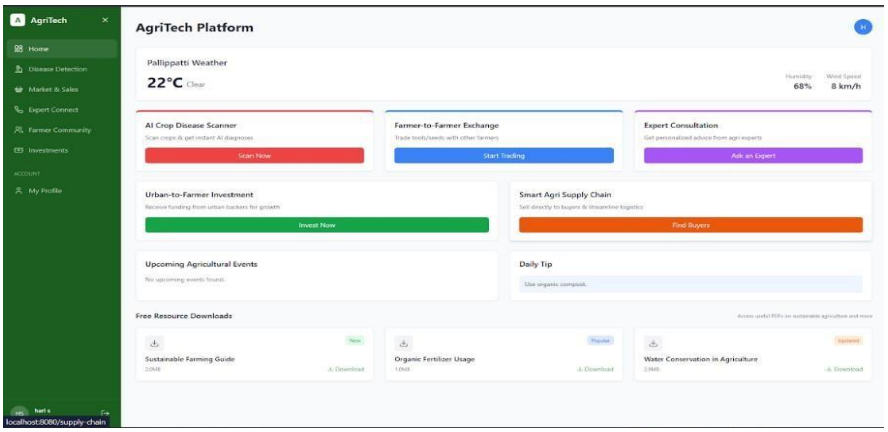

Fig:1.11

2. AI Crop Disease Scanner Module
The AI Crop Disease Scanner page, which lets farmers upload images of their crops for instant disease assessment. Users can upload multiple images for improved precision or activate the camera and scan items in real time. The page should provide guidelines through notes and clear controls about how uploaded data should be analysed or managed.

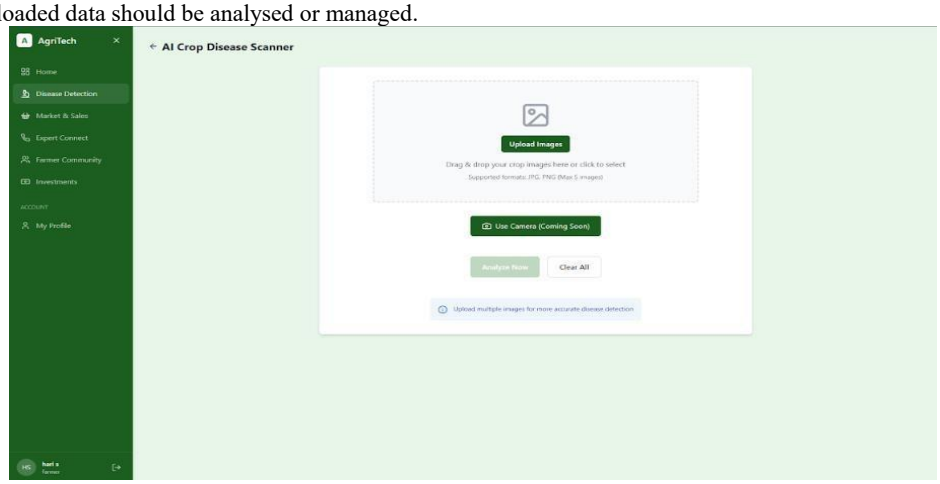

Fig.1.12

3. Scan Result page
The Scan Results page, where a user can view the detailed results of the disease diagnosis of the uploaded crop image. The system provides the identified disease with confidence levels, followed by explicit prevention and treatment suggestions. Besides this, users can download the diagnosis report in PDF format for future reference.

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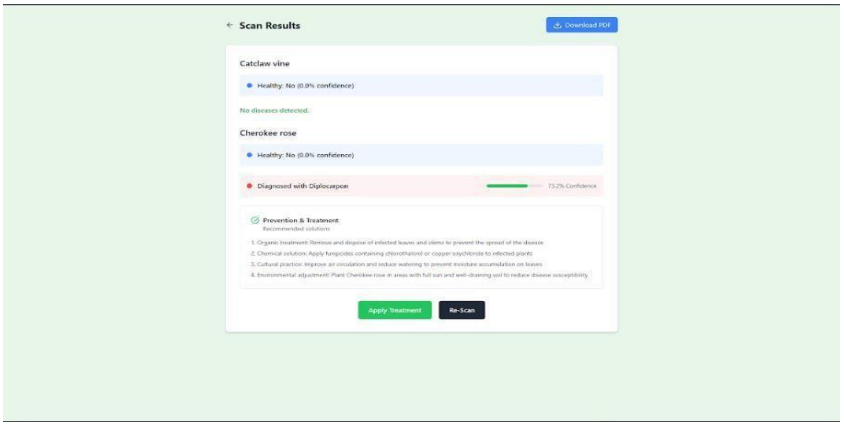

Fig:1.13

4. Marketplace module

This module introduces the marketplace for the agricultural products, where one can Buy and sell the products, which is environment friendly and sustainable agricultural product. Here farmers can post the product to sell and buyers can purchase the product. This is the platform for the marketplace.

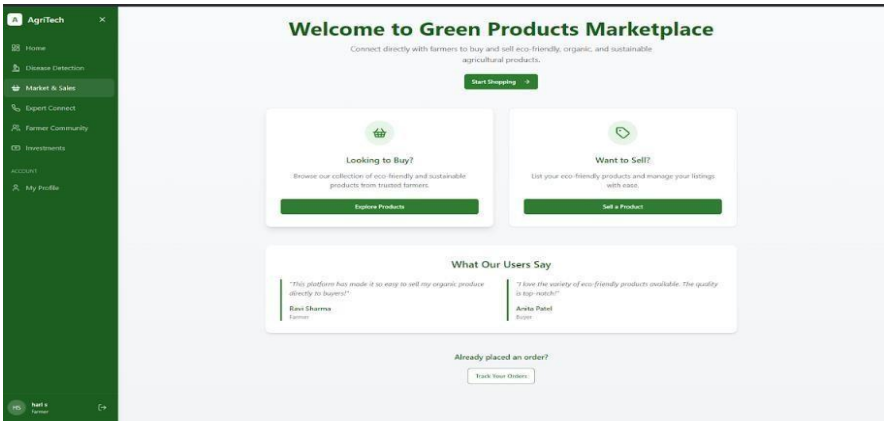

Fig:1.14

5. Delivery Details page

This page shows the delivery details and the order summary of the user, and it allows them to view the entire information of the delivery for the further checkouts. The user can choose the method of delivery, contact details, and the delivery address. The user can make payments safely during the purchase process after the providing all the required details.

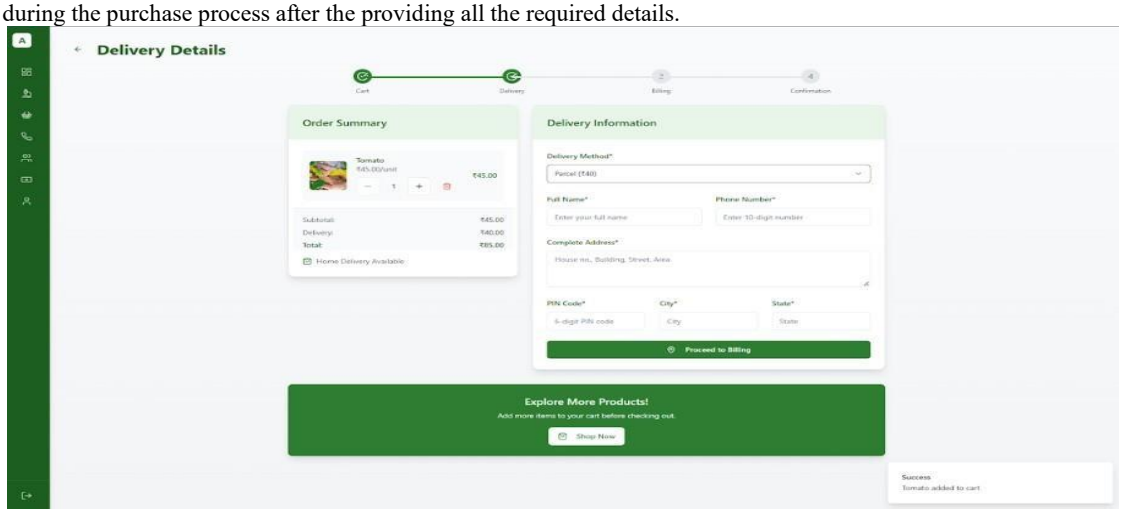

Fig:1.17

6. Expert Consultation Module

This page shows the delivery details and the order summary of the user, and it allows the to view the entire information of the delivery for the further checkouts. The user can choose the method of delivery, contact details, and the delivery address. The user can make payments safely during the purchase process after the providing all the required details.

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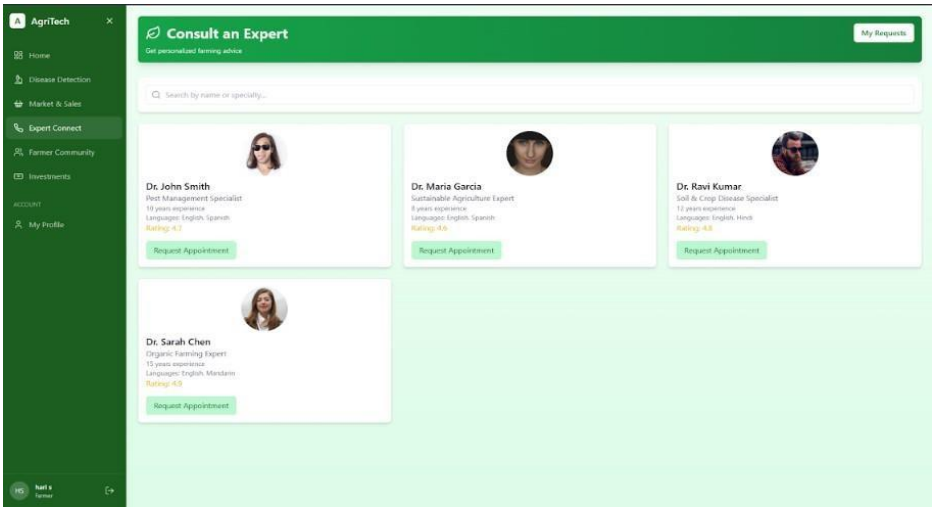

Fig:1.15

7. Appointment page

This page shows the delivery details and the order summary of the user, and it allows the to view the entire information of the delivery for the further checkouts. The user can choose the method of delivery, contact details, and the delivery address. The user can make payments safely during the purchase process after the providing all the required details.

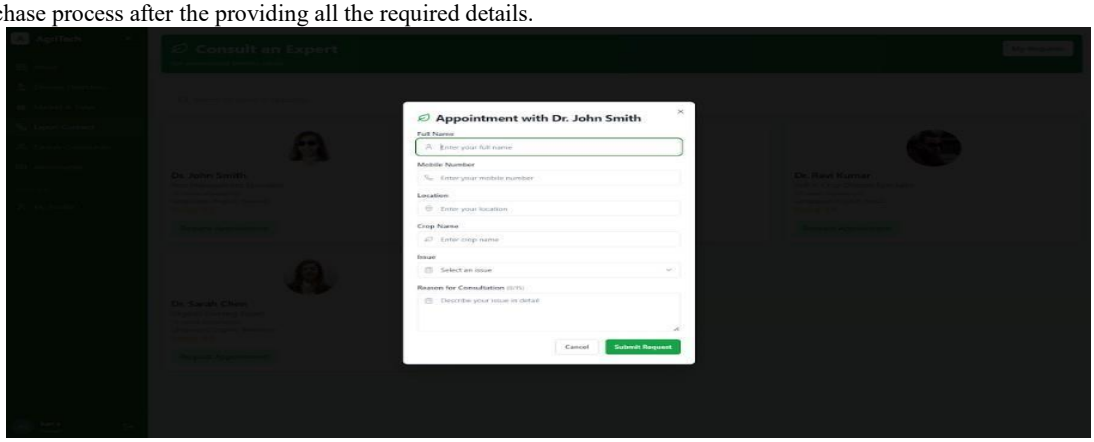

Fig:1.17

8. Bulk Buyers page

In this module the buyers can request different types of agricultural products posted by the farmers. All the request which includes product name, quantity needed by them, the location of the buyer, and the duration. The farmers will get know about the orders in the notification and they will respond quickly and make the order confirmed and they will directly contact the buyers.

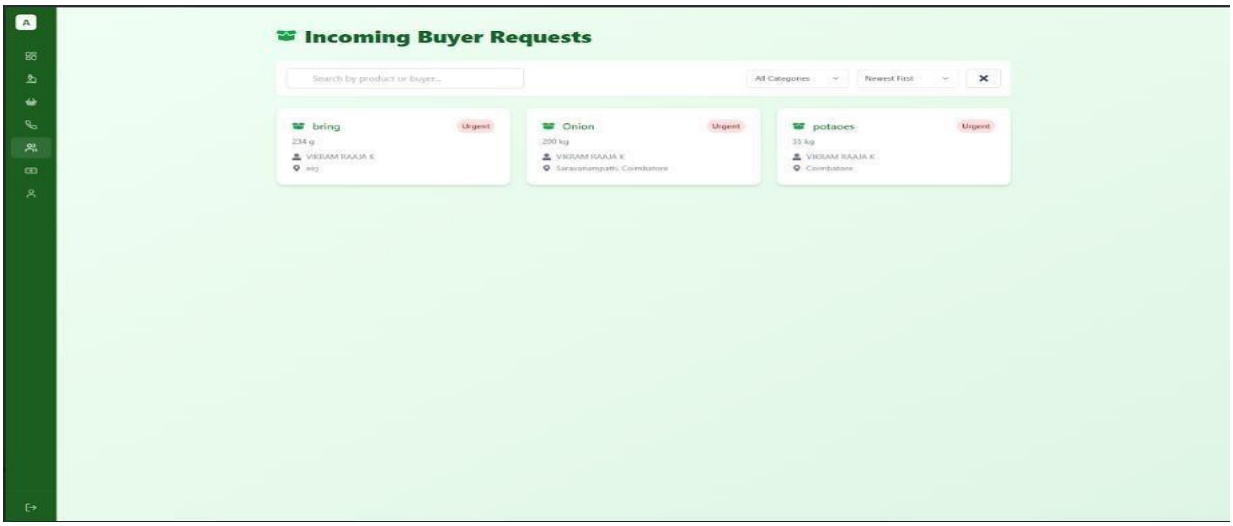

Fig:1.17

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Database Design (ER Description)

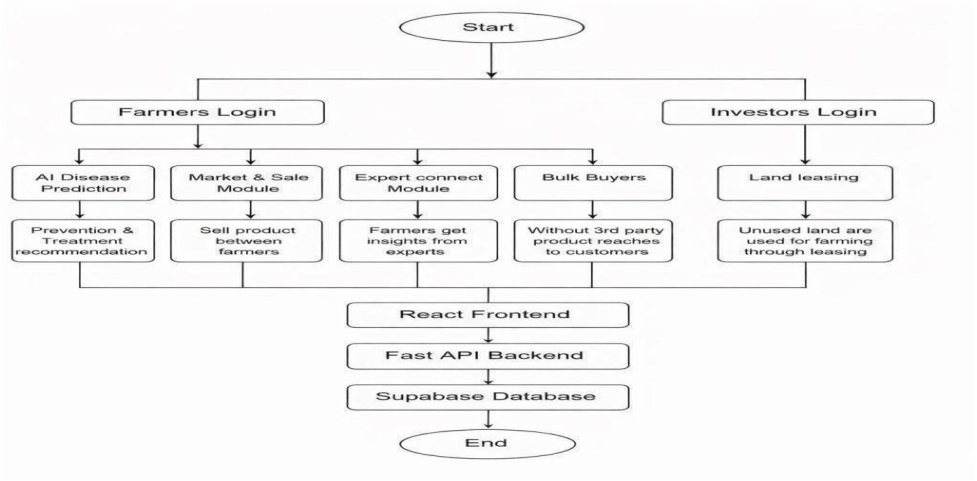

Fig:1.18

VII. IMPLEMENTATION

The AI-Based Smart Agriculture Platform is a web program that uses a digital platform as a basis for serving as a link between buyers, investors, farmers, and professionals in the agricultural sector. The program was designed with the goal of attaining responsiveness and scalability; therefore, React.js is used for the frontend development, FastAPI for the backend development, and Supabase (PostgreSQL) for database management development. The development of a secure user authentication module for users to register with the program was the first process in developing this program. The users will be able to access the digital market, seek advice from professionals, interact with other farmers, and share images of the crops in order to identify the diseases after registering with the program. If the farmer is able to upload a picture of the crops, then the program uses crop disease detection models based on AI, which helps in identifying the diseases that are likely to be in the crops, as well as the remedies, based on the picture taken of the crops. The farmers are also able to keep track of the crops they own and are in a position to make the right decisions based on the data stored in the database, which is reflected on the dashboard.

VIII. Results & Discussion

The functionality, usability, and effectiveness of the developed AI-Based Smart Agriculture Platform in the facilitation of modern modes of farming were determined. The platform allows users to register, upload photos of their crops for disease identification, utilize the services of professional advisors, collaborate with other users, and communicate with buyers through the online market place. The platform was able to demonstrate the effective communication of backend services built with FastAPI and frontend built with React.js during the testing process. For the effective management of the platform, the Supabase database was able to store user profiles, results of crop analysis, marketplace items, advise requests, and logs of the platform activity.

With the help of AI-based agricultural disease detection models, it is now possible to identify plant diseases quickly and accurately. This helps farmers to take necessary precautions at an early stage. The management of farms has also been improved by allowing farmers to access crop analysis data directly on their dashboard. Moreover, farmers can now display their agricultural products for sale to end-users through the marketplace module of the system. This increases openness in the system and reduces dependence on middlemen. Another module in this system is investor-farmer land leasing module, in which investors can lease land to farmers to increase agricultural production. Based on all these aspects, it can be said that this system performed well in terms of reliability, data processing, and practical usage.

IX. Advantages

The proposed AI-Based Smart Agriculture Platform will be able to provide a viable and efficient mechanism for conducting the existing farming activities. This is because the web application will enable the farmers to upload the images of their crops in order to identify the disease, avail professional advice services, associate with other farmers, and communicate with their customers through a simple mechanism. This will not only enable the farmers to avail the necessary information and advice in a timely manner but also simplify the existing farming activities in a manner that the farmers will be able to take wise and timely decisions. the different kinds of plant diseases at an early stage and apply the necessary treatment techniques in order to avoid the loss of crops, is one of the major advantages of the proposed system. In addition, the farmers will be able to sell their farm products to the large customers through the digital marketplace mechanism in an efficient and fair price.

X. Limitations

Although the proposed AI-Based Smart Agriculture Platform has provided a good and comprehensive solution for modern-day farming activities, it has many major demerits associated with it. The first major drawback of the proposed system is the need for a reliable internet connection. As the proposed system is a web-based application, it is important that the users have a reliable internet connection so that they can communicate with other farmers, upload their crop images to identify the diseases, access the professional advisory service, and participate in the online marketplace. It is possible that the internet connectivity will not be reliable in the rural areas where the farmers are engaged in their activities.

Another disadvantage associated with the model is the reliance on the availability of the datasets and the accuracy of the AI model. The quality of the datasets used to train the machine learning model has a direct impact on the accuracy of the detection of crop diseases It is possible that the accuracy of the results may not be the best at certain times, depending on the quality of the crop images uploaded on the platform, which may vary in terms of the light condition, crop types, and environmental factors. In addition, the consistency of the decision support may vary depending on the availability of real-time environmental data and market information in the regions. However, the reliability of the platform can be taken to the next level with the development of the model.

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XI. Future Scope

Despite the fact that the proposed AI-Based Smart Agriculture Platform is a good technological innovation to assist modern farming activities, there are a number of improvements that can be made to the system in the future to enhance its scalability and usability. For example, the creation of a mobile application using Android and iOS platforms can be a major improvement to the system, as it can enable users to upload their images, obtain disease diagnosis results, access advising services, and view market activities using their mobile devices. This can enhance its usability, as it can be accessed anywhere in the farming regions. Future versions of the platform could even have Internet of Things-based environmental monitoring systems integrated into them, enabling the collection of data regarding temperature, humidity, soil moisture, etc., through IoT sensors. Moreover, the platform could even have advanced predictive analytics for better agricultural yield predictions, enabling the farmers to make better financial decisions by analyzing the data provided by the system. The reliability of the system would be increased, and the decisions provided by the system would even align with the decisions provided by the government's agricultural department, if the system were integrated with the government's agricultural department databases. This would make the system more intelligent, enabling the implementation of sustainable agriculture practices and precision agriculture at a large scale. **XII. Conclusion**

The following is a complete smart agriculture framework powered by AI that monitors crop health, provides expert consultation, ensures farmer collaboration, and enhances market and supply chain operations using advanced machine learning and deep learning techniques. The combination of Fast API for efficient backend processing with React.js for an appealing frontend interface, along with Supabase for secure real-time management of the database, ensures the system is scalable, dependable, and user-friendly. It serves as a useful decision-support tool by providing real-time crop disease detection, predictive analytics, expert advice, and structured reporting. The proposed platform will be further enhanced with intelligent classification algorithms and superior real-time monitoring capabilities. The performance of the system can be enhanced further by using larger and more diverse agricultural datasets that can allow for finer personalization across crop types and regions. The model can also be integrated into government portals, Agri-enterprise platforms, and smart city initiatives to promote precision farming and data-driven agricultural methodologies for enhanced access and sustainability.

XII. References

[1] L. García et al., "IoT-Based Smart Irrigation Systems: An Overview on the Recent Trends on Sensors and IoT Systems for Irrigation in Precision Agriculture," *Sensors*, vol. 20, no. 4, art. 1042, 2020, doi: 10.3390/s20041042.
[2] E. Navarro et al., "A Systematic Review of IoT Solutions for Smart Farming," *Sensors*, vol. 20, no. 15, art. 4231, 2020, doi: 10.3390/s20154231.
[3] B. Ramalingam et al., "Remote Insects Trap Monitoring System Using Deep Learning Framework and IoT," *Sensors*, vol. 20, no. 18, art. 5280, 2020, doi: 10.3390/s20185280.
[4] D. Popescu et al., "Advanced UAV–WSN System for Intelligent Monitoring in Precision Agriculture," *Sensors*, vol. 20, no. 3, art. 817, 2020, doi: 10.3390/s20030817
[5] P. Bansal, R. Kumar, and S. Kumar, "Disease Detection in Apple Leaves Using Deep Convolutional Neural Network," *Agriculture*, vol. 11, no. 7, art. 617, 2021, doi:
10.3390/agriculture11070617.
[6] J. Lu et al., "CNN Applied to Plant Leaf Disease Classification: A Review," *Agriculture*, vol. 11, no. 8, art. 707, 2021, doi: 10.3390/agriculture11080707.
[7] *M. Dhanaraju et al., "Smart Farming: Internet of Things (IoT)-Based Sustainable Agriculture," Agriculture, vol. 12, no. 10, art. 1745, 2022.*
[8] *J. Eunice et al., "Deep Learning-Based Leaf Disease Detection in Crops Using Images for Agricultural Applications," Agronomy, vol. 12, no. 10, art. 2395, 2022.*
[9] *H. Wang et al., "Plant Disease Detection and Classification Method Based on Optimized Lightweight YOLOv5," Agriculture, vol. 12, no. 7, art. 931, 2022.*
[10] *L. W. Kuswidiyanto et al., "Plant Disease Diagnosis Using Deep Learning Based on UAV-Borne Hyperspectral Remote Sensing: A Review," Remote Sensing, vol. 14, no. 23, art. 6031, 2022.*
[11] D. Vallejo-Gómez et al., "Smart Irrigation Systems in Agriculture: A Systematic Review," *Agronomy*, vol. 13, no. 2, art. 342, 2023.
[12] V. S. Dhaka et al., "Role of Internet of Things and Deep Learning Techniques in Plant Disease Monitoring and Classification: A Review," *Sensors*, vol. 23, no. 18, art. 7877, 2023.
[13] J. Liu et al., "Survey of Intelligent Agricultural IoT Based on 5G," *Electronics*, vol. 12, no. 10, art. 2336, 2023.
[14] M. Shoaib et al., "An advanced deep learning models-based plant disease detection: A review of recent research," *Frontiers in Plant Science*, vol. 14, art. 1158933, 2023.
[15] X. Gong et al., "Apple Leaf Disease Detection Based on an Improved Faster RCNN," *Agriculture*, vol. 13, no. 2, art. 240, 2023.
[16] R. Elashmawy et al., "Precision Agriculture Using Soil Sensor Driven Machine Learning," *Sensors*, vol. 23, no. 4, art. 2247, 2023.
[17] H. N. Ngugi et al., "Machine Learning and Deep Learning for Crop Disease Diagnosis: A Review," *Agronomy*, vol. 14, no. 12, art. 3001, 2024.
[18] A. Soussi et al., "Smart Sensors and Smart Data for Precision Agriculture," *Sensors*, vol. 24, no. 8, art. 2647, 2024.
[19] R. Guebsi et al., "Drones in Precision Agriculture: A Comprehensive Review," *Drones*, vol. 8, no. 11, art. 686, 2024.
[20] J. Wang et al., "Integration of Remote Sensing and Machine Learning for Precision Agriculture: A Review," *Agronomy*, vol. 14, no. 9, art. 1975, 2024.
[21] M. Del-Coco et al., "Machine Learning for Smart Irrigation in Agriculture," *Information*, vol. 15, no. 6, art. 306, 2024.
[22] B. Nsoh et al., "Internet of Things-Based Automated Solutions Utilizing Machine Learning for Smart Irrigation," *Sensors*, vol. 24, no. 23, art. 7480, 2024.
[23] H. Lee et al., "A Deep Learning-Based Crop Disease Diagnosis Method Using Multimodal Data," *Applied Sciences*, vol. 14, no. 10, art. 4322, 2024.
[24] H. Zhu et al., "Intelligent Agriculture: Deep Learning in UAV-Based Remote Sensing: A Review," *Frontiers in Plant Science*, 2024
[25] M. El Sakka et al., "A Review of CNN Applications in Smart Agriculture Using Sensors and Imagery," *Sensors*, vol. 25, no. 2, art. 472, 2025.
[26] S. Wang et al., "Advances in Deep Learning Applications for Plant Disease and Pest Detection: A Review," *Remote Sensing*, vol. 17, no. 4, art. 698, 2025.
[27] Y. M. Qin et al., "Deep Learning for Sustainable Agriculture: A Systematic Review," *Sustainability*, vol. 17, no. 7, art. 3190, 2025.
[28] J. Botero-Valencia et al., "Machine Learning in Sustainable Agriculture: Systematic Review," *Agriculture*, vol. 15, no. 4, art. 377, 2025.
[29] A. Ali et al., "Smart Irrigation Technologies and Prospects for Enhancing Agricultural Water Efficiency: A Review," *AgriEngineering*, vol. 7, no. 4, art. 106, 2025.
[30] N. C. Gaitan et al., "Integrating Artificial Intelligence into an Automated Irrigation System," *Sensors*, vol. 25, no. 4, art. 1199, 2025.