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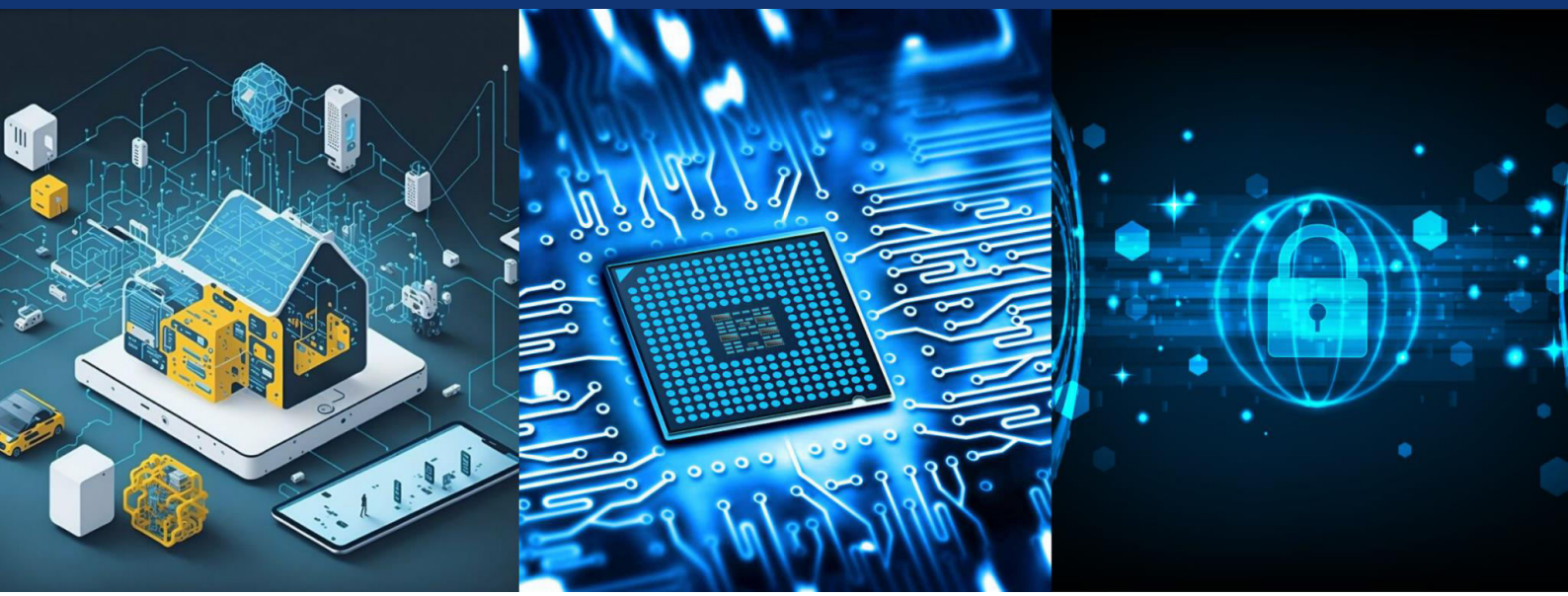

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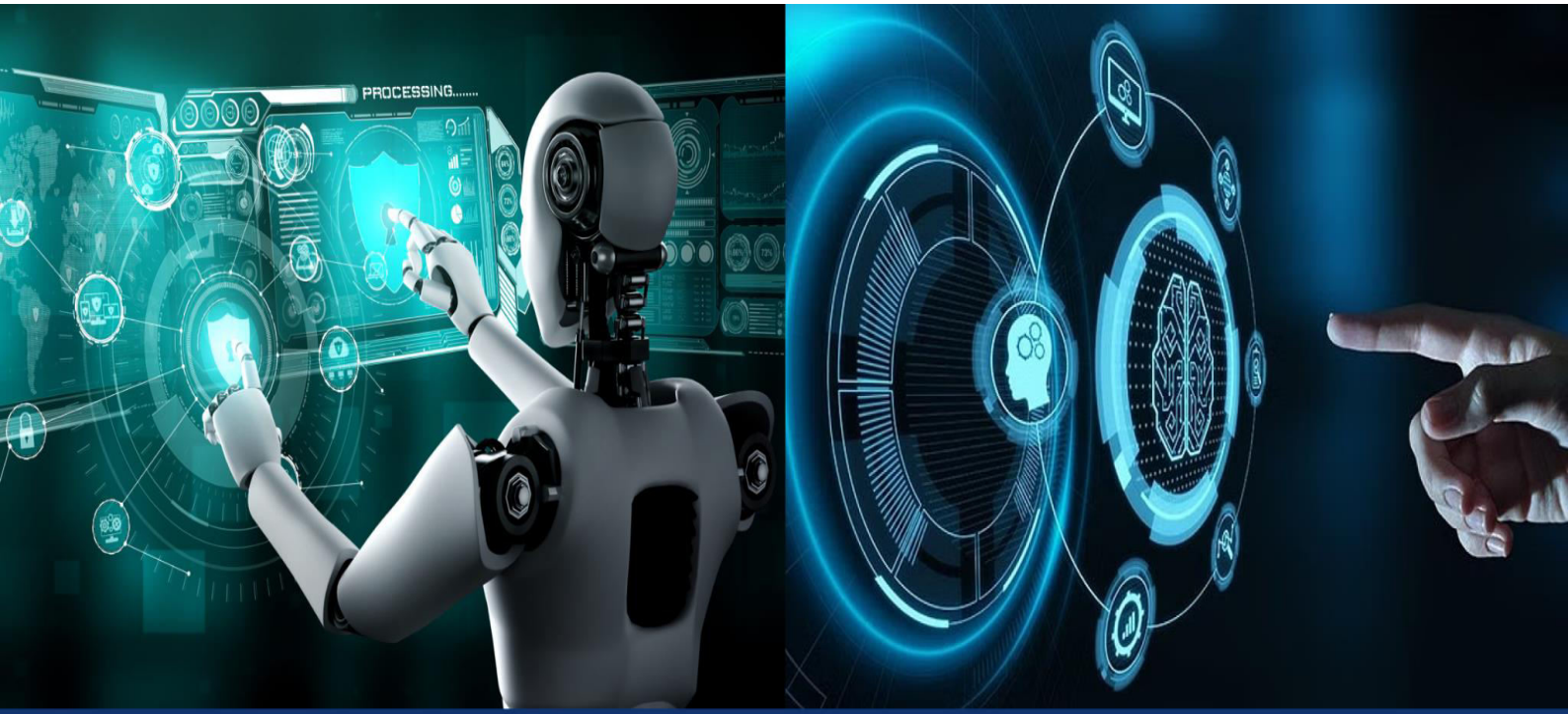

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Smart Crop Advisory System an AI – Powered Web Framework for Personalized Agricultural Decision Support

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ABSTRACT: Agriculture is the back bone of the Indian economy, and millions of farmers depend on successful crop cultivation for their livelihoods. However, the lack of personalized, data-driven guidance leads to poor crop selection, significant pest-related losses, and missed market opportunities. This paper presents the "Smart Crop Advisory System", an intelligent AI-powered web application designed to assist farmers in making well-informed agricultural decisions. The proposed system utilizes Google Gemini AI as its core machine learning engine to deliver personalized crop recommendations based on soil type, pH value, geographic location, and preferred crop categories. The framework integrates real-time weather forecasting through the Open Weather API, AI-based pest detection through image analysis, live market price monitoring, and a nearby agricultural store locator within a unified web platform. The system is developed using React.js on the frontend and Supabase PostgreSQL for data storage. Experimental evaluation demonstrates that the proposed system provides accurate, fast, and user-friendly agricultural advisory services, enabling early pest detection, optimal crop planning, and improved farmer profitability.

KEYWORDS: Smart Agriculture, Artificial Intelligence, Crop Recommendation, Pest Detection, Google Gemini AI, React.js, Supabase, OpenWeather API, Market Price Monitoring, Precision Farming.

I. INTRODUCTION

Agriculture is one of the most important sectors of the Indian economy, providing employment to a large population and contributing significantly to economic growth. However, farmers face several challenges such as unpredictable weather conditions, soil degradation, pest attacks, and limited access to accurate market information. Most farmers still depend on traditional farming methods and personal experience while making agricultural decisions.

Recent advancements in Artificial Intelligence (AI) have introduced smarter approaches to agriculture by analyzing soil characteristics, weather conditions, and crop data to provide accurate recommendations. AI-based advisory systems help farmers improve productivity, reduce cultivation costs, and make informed decisions. These technologies support sustainable farming by offering timely and data-driven guidance.

The proposed **"Smart Crop Advisory System"** is an AI-powered web application designed to assist farmers in crop selection, pest detection, weather forecasting, and market price analysis. The system integrates Google Gemini AI, OpenWeather API, and a cloud database to provide personalized recommendations through a simple, user-friendly, and multilingual interface, enabling farmers to make better agricultural decisions.

II. LITERATURE REVIEW

Artificial Intelligence (AI) has transformed modern agriculture by improving crop selection, disease detection, and farm management. Machine learning and computer vision techniques help farmers make accurate decisions using soil, weather, and crop data [4][5]. These technologies have increased productivity while reducing manual effort.

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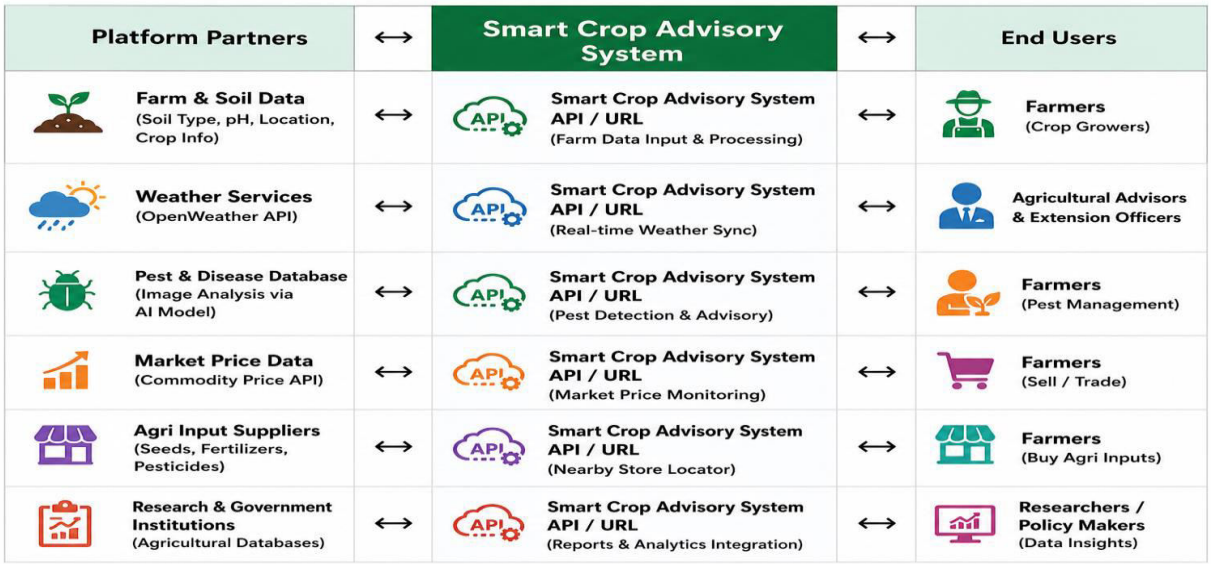
Several researchers have applied deep learning models such as Convolutional Neural Networks (CNNs) for plant disease detection from leaf images. Machine learning algorithms like Random Forest and Gradient Boosting have also been successfully used for crop recommendation by analyzing environmental and soil parameters [6][7][8]. These approaches have demonstrated high prediction accuracy and reliability.

Recent advancements in Large Language Models (LLMs), such as Google Gemini AI, have further enhanced agricultural advisory systems by providing intelligent recommendations using text, images, weather forecasts, and market information [9][10][11][12]. Based on these studies, the proposed Smart Crop Advisory System integrates AI-based crop recommendations, pest detection, weather forecasting, and market price analysis into a single platform.

III. SYSTEM OVERVIEW

The Smart Crop Advisory System is an AI-driven agricultural advisory platform developed to assist farmers in making data-driven decisions about crop selection, pest management, and market timing. The system analyzes farm specific parameters including soil type, soil pH value, geographic location, current crop, and preferred crop category to generate personalized recommendations using Google Gemini AI.

The framework consists of six major modules: Crop Recommendation, Weather Forecasting, Pest Detection, Market Price Dashboard, Nearby Store Locator, and AI Chatbot. After processing the farmer's input data, the AI engine generates a detailed advisory report with recommended and non-recommended crops with match percentages, 7-day weather forecasts, pest identification and treatment plans, and current commodity prices. The system is designed to provide accurate, fast, and user-friendly outputs, enabling early pest detection and supporting better agricultural planning.



IV. METHODOLOGY

The development of the Smart Crop Advisory System follows a structured, iterative approach to ensure accurate and reliable agricultural advisory outputs. The methodology consists of the following phases.

4.1 Farm Data Collection

The farmer enters details such as soil type, soil pH, location, and crop information through the application. This data is used as the input for generating personalized crop recommendations.

4.2 AI-Powered Crop Analysis

The application retrieves real-time weather data using the OpenWeather API. Farmers can view temperature, humidity,

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rainfall, and weather conditions to plan farming activities effectively.

4.3 Weather Data Integration

The application retrieves real-time weather data using the OpenWeather API. Farmers can view temperature, humidity, rainfall, and weather conditions to plan farming activities effectively.

4.4 Pest Detection and Analysis

Farmers upload crop leaf images to identify diseases and pests. Google Gemini AI analyzes the image and provides the disease name, treatment methods, and preventive measures.

4.5 Market Price Monitoring

The system displays the latest market prices of agricultural crops. Farmers can compare prices and choose the right time and market to sell their produce.

4.6 Performance Evaluation

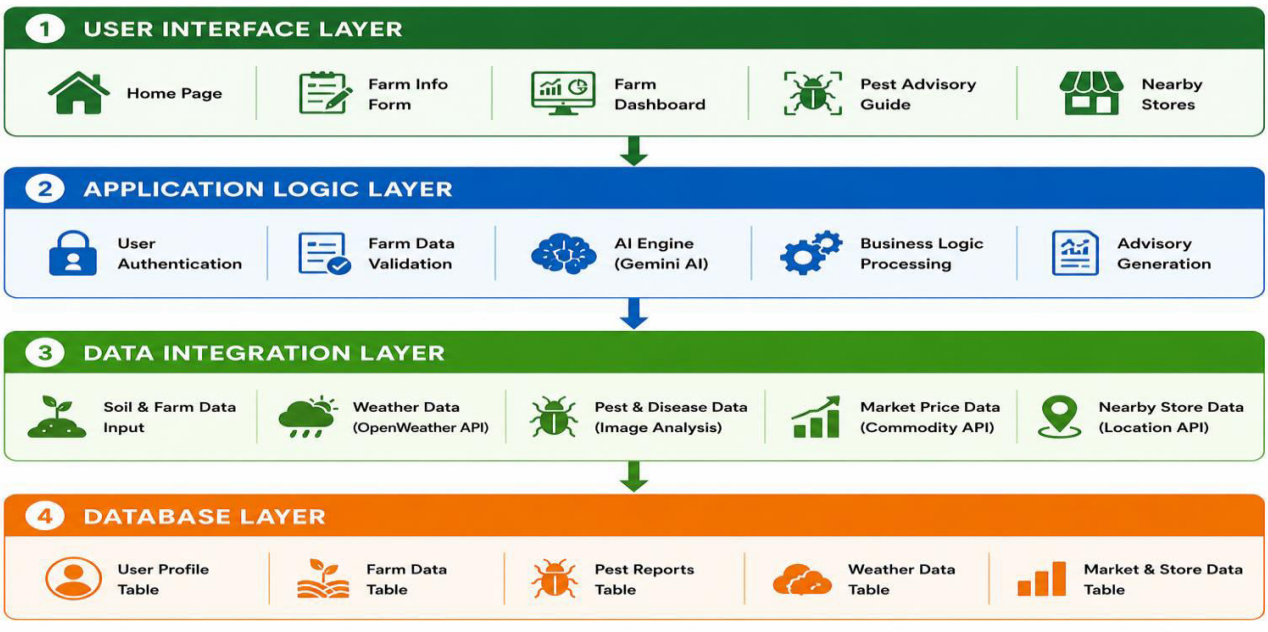
The system performance is evaluated using functional and non-functional test cases covering all modules. Evaluation metrics include response accuracy of AI recommendations, pest identification correctness, weather data freshness, and user interface responsiveness across different devices and browsers.

V. SYSTEM ARCHITECTURE

The Smart Crop Advisory System follows a three-tier client-server architecture that ensures efficient communication between the user interface, AI services, and cloud database while maintaining security and performance.

The system consists of six architectural layers: User Interface Layer, AI Processing Layer, External API Integration Layer, Data Storage Layer, Business Logic Layer, and Output and Reporting Layer.

The User Interface Layer is built using React.js and delivers an interactive, mobile-responsive web application. The AI Processing Layer integrates Google Gemini AI to handle crop recommendation generation and pest image analysis. The External API Integration Layer manages communication with the OpenWeather API for weather forecasting and the Market Price API for commodity pricing. The Data Storage Layer uses Supabase PostgreSQL for user authentication, data persistence, and history management. The Business Logic Layer handles data transformation, prompt engineering, and API response parsing. The Output and Reporting Layer presents all analytical results through an organized Farm Dashboard with charts, tables, and recommendation cards [13].



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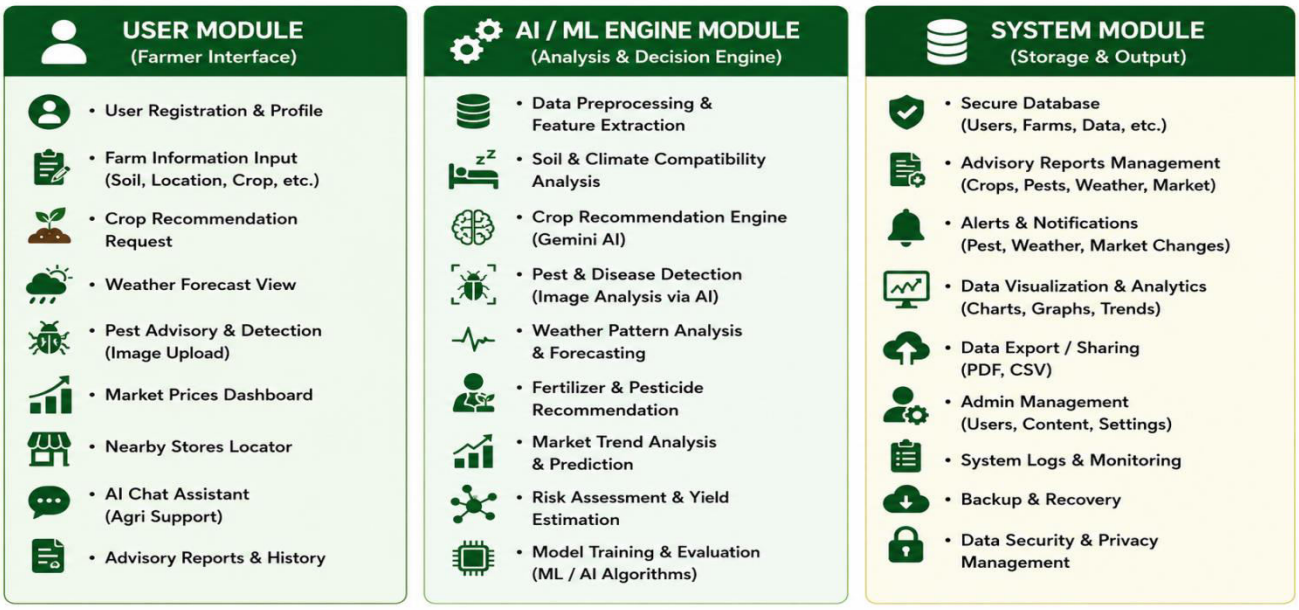
VI. MODULES



6.1 User Module (Farmer Interface)

The User Module provides an easy-to-use interface for farmers to register, enter farm details, upload crop images, and access AI-powered services. Farmers can receive crop recommendations, check weather forecasts, view market prices, locate nearby agricultural stores, and interact with the AI chatbot. The module is designed to provide a simple and user-friendly experience for efficient agricultural decision-making.

6.2 AI / ML Engine Module (Analysis & Decision Engine)

The AI/ML Engine Module is the core component of the Smart Crop Advisory System. It analyzes soil information, weather conditions, and crop images using Google Gemini AI to generate personalized crop recommendations, detect pests and diseases, provide treatment suggestions, and analyze market information. This intelligent processing helps farmers make accurate and data-driven farming decisions.

6.3 System Module (Storage & Output)

The System Module securely stores user information, crop recommendations, pest reports, weather data, and market prices using Supabase PostgreSQL. It manages data processing, generates reports, displays results through the dashboard, and ensures secure access to user information. This module provides reliable data management and supports the smooth operation of the entire application.

VII. IMPLEMENTATION DETAILS

7.1 Technology Stack

The Smart Crop Advisory System is developed using **React.js** and **Tailwind CSS** for the frontend. **Google Gemini AI** is used for crop recommendation and pest detection, while **Supabase PostgreSQL** manages authentication and database operations.

7.2 Frontend Implementation

The application provides a responsive and user-friendly interface with pages such as Home, Farmer Input Form, Dashboard, Pest Detection, and AI Chatbot. The interface is designed to work smoothly on both desktop and mobile devices.

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7.3 Backend and API Implementation

The system integrates **Google Gemini AI**, **OpenWeather API**, and **Supabase** to provide crop recommendations, weather updates, pest detection, and secure data storage. These services work together to deliver real-time agricultural information.

7.4 Database Design

The database stores user details, crop recommendations, pest reports, weather information, market prices, and chatbot history using **Supabase PostgreSQL**.

7.5 AI Model Implementation

Google Gemini AI analyzes farmer inputs and crop images to generate accurate crop recommendations, identify pests or diseases, and provide suitable treatment suggestions.

7.6 Security Measures

The application secures user data through authentication, encrypted API keys, input validation, and protected database access. These measures ensure data privacy and secure system operation.

VIII. EXPERIMENTAL DETAILS AND RESULTS

8.1 Experimental Setup

The Smart Crop Advisory System was implemented and tested using React.js v18, Node.js v18, and the @google/generative-ai SDK v0.2.0. Testing was conducted on a development system with Intel Core i5 processor, 8GB RAM, and Windows 11 operating system. The application was tested on Chrome, Firefox, and Edge browsers, and on mobile devices with screen widths ranging from 390px to 1920px. Farm data inputs from the Srikakulam.

8.2 Test Results

TestCase	Description	Result	Status
UserNavigation	Home,Form,Dashboard,Pest pages load correctly	Passed	✓
FarmDataInput	Entersoiltype,pH,location,crop category	Passed	✓
AICropRecommendation	GeminiAIreturnscroplistwith match percentages	Passed	✓
WeatherChartDisplay	7-dayforecastrendersasbarand line charts	Passed	✓
MarketPriceDashboard	Croppriceswith24htrendarrows displayed	Passed	✓
PestImageUpload	Leafimageuploadedandpreviewed correctly	Passed	✓
PestIdentification	AIidentifiespestwithsymptoms and severity	Passed	✓
PesticideRecommendations	NeemOil,Imidacloprid,Soap Solution shown	Passed	✓
SprayInstructions	4-stepinstructionswithsafetytips displayed	Passed	✓
NearbyShopsDisplay	4shopswithaddressandCallNow button shown	Passed	✓

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MobileResponsiveness	Applicationdisplayscorrectlyon 390px screen	Passed	✓
Cross-BrowserTesting	Chrome,Firefox,Edgerender consistently	Passed	✓

Table1: Test Case Results for Smart Crop Advisory System

8.3 Performance Evaluation

The system performance was evaluated using all major modules, including crop recommendation, pest detection, weather forecasting, and market price analysis. The application generated accurate results with minimal response time, and all functional test cases were executed successfully. The user interface performed smoothly across different browsers and devices, ensuring a reliable user experience.

8.4 Observations

The proposed Smart Crop Advisory System successfully generated suitable crop recommendations based on soil type, pH value, and weather conditions. The pest detection module accurately identified diseases from uploaded leaf images and provided appropriate treatment suggestions. The weather and market price modules also delivered real-time information, helping farmers make informed decisions for better crop management and productivity.

IX. APPLICATIONS

- **Personalized Crop Recommendation:** Recommends suitable crops based on soil type, pH value, and weather conditions to improve productivity.
- **Pest and Disease Detection:** Identifies crop pests and diseases from leaf images using AI, enabling early treatment and reducing crop loss.
- **Weather-Based Planning:** Provides weather forecasts to help farmers plan irrigation, pesticide application, and harvesting activities effectively.
- **Market Price Analysis:** Displays real-time crop market prices, helping farmers choose the best time to sell their produce.
- **Agricultural Support:** Helps farmers find nearby agricultural stores for seeds, fertilizers, and pesticides.
- **Remote Farming Assistance:** Provides AI-based agricultural guidance to farmers in rural and remote areas.
- **Sustainable Farming:** Promotes eco-friendly farming practices by recommending crops suitable for local soil and climate conditions.

X. LIMITATIONS

- **Data Dependency:** The accuracy of crop recommendations depends on the quality of the soil and crop data provided by users.
- **Image Quality:** Pest detection requires clear leaf images; poor-quality images may reduce prediction accuracy.
- **Internet Requirement:** The system needs an active internet connection to access AI, weather, and market APIs.
- **Limited Market Coverage:** Market price information may not include all regional crops or local markets.
- **Language Support:** The current version supports only English, limiting accessibility for regional-language users.
- **API Limitations:** External API rate limits may affect system performance during heavy usage.
- **Expert Validation:** AI-generated recommendations should be verified by agricultural experts before large-scale implementation.

XI. FUTURE ENHANCEMENTS

The future scope of the **"Smart Crop Advisory System"** includes enhancing the application with more advanced features to improve farming efficiency and user experience. Support for additional regional languages and voice-based interaction can make the system more accessible to farmers from different regions.

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Future versions can integrate IoT sensors to automatically collect soil and environmental data, improving the accuracy of crop recommendations. Offline access through Progressive Web App (PWA) technology can also help farmers use the application in areas with limited internet connectivity.

The system can be further enhanced by incorporating advanced AI models for better pest detection, crop yield prediction, drone-based crop monitoring, and a farmer community platform for sharing agricultural knowledge and best practices. These improvements will make the system more intelligent, reliable, and beneficial for sustainable agriculture.

XII. CONCLUSION

The "**Smart Crop Advisory System"** is an AI-based web application developed to support farmers in making better agricultural decisions. By integrating **Google Gemini AI**, **OpenWeather API**, and **Supabase**, the system provides crop recommendations, pest detection, weather forecasting, and market price information through a single platform.

The application offers a simple, responsive, and user-friendly interface that enables farmers to access accurate and real-time agricultural information. The integration of multiple modules improves farming efficiency, reduces crop losses, and supports informed decision-making.

Overall, the proposed system provides a reliable and cost-effective solution for modern agriculture. With future enhancements such as multilingual support, IoT integration, offline access, and advanced AI models, the Smart Crop Advisory System can become a comprehensive platform for smart and sustainable farming.

REFERENCES

[1] N. H. Kulkarni, G. N. Srinivasan, B. M. Sagar, and N. K. Cauvery, "Improving Crop Productivity Through a Crop Recommendation System Using Ensembling Technique," in Proc. IEEE Int. Conf. System, Computation, Automation and Networking (ICSCAN), 2018.
[2] G. Davrazos, T. Panagiotakopoulos, S. Kotsiantis, and A. Kameas, "IoT-Enabled Crop Recommendation in Smart Agriculture Using Machine Learning," in Proc. IEEE Int. Conf. Information, Intelligence, Systems and Applications (IISA), 2023.
[3] T. Dey, S. Roy, A. Chatterjee, and P. Banerjee, "iCrop: An Intelligent Crop Recommendation System for Agriculture 5.0," IEEE Transactions on AgriFood Electronics, vol. 2, no. 2, pp. 587–595, 2024.
[4] A. Bhola and P. Kumar, "Farm-Level Smart Crop Recommendation Framework Using Machine Learning," Annals of Data Science, vol. 11, no. 1, pp. 1–18, 2024.
[5] K. B. Kancharagunta, S. Reddy, and V. Rao, "Crop Recommendation System Using Machine Learning and IoT: A Survey," Lecture Notes in Networks and Systems, vol. 890, pp. 233–245, 2024.
[6] O. Turgut, I. Kok, and S. Ozdemir, "AgroXAI: Explainable AI-Driven Crop Recommendation System for Agriculture 4.0," arXiv preprint arXiv:2412.16196, 2024.
[7] R. Sharma and A. Jain, "Crop Yield Prediction Using Machine Learning Techniques," International Journal of Agricultural Informatics, vol. 9, no. 1, pp. 45–53, 2023.
[8] P. Patel and S. Shah, "Crop Recommendation Using Random Forest Algorithms," International Journal of Computer Applications, vol. 182, no. 12, pp. 15–21, 2022.
[9] M. Reddy and V. Kumar, "Decision Tree-Based Crop Recommendation Models," Journal of Intelligent Agriculture, vol. 6, no. 3, pp. 88–96, 2023.
[10] S. Gupta and N. Mishra, "Support Vector Machine for Crop Classification," Computers and Electronics in Agriculture, vol. 190, p. 106450, 2021.
[11] Y. Chen and H. Zhao, "XGBoost Applications in Agriculture," Artificial Intelligence in Agriculture, vol. 5, pp. 55–63, 2022.
[12] L. Wang, J. Li, and P. Sun, "Deep Learning for Crop Disease Detection," IEEE Access, vol. 9, pp. 123456–123468, 2021.
[13] K. Rao and D. Prasad, "IoT-Enabled Precision Farming Systems," International Journal of Sensor Networks, vol. 14, no. 2, pp. 67–75, 2022.
[14] T. Verma and R. Singh, "Soil Nutrient Prediction Using Artificial Intelligence," Journal of Soil Science and Plant

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Nutrition, vol. 22, no. 4, pp. 1120–1130, 2022.
[15] A. Das and S. Ghosh, "Fertilizer Recommendation Using Machine Learning," Agricultural Systems, vol. 196, p. 103332, 2022.
[16] P. Nair and V. Menon, "Weather-Based Crop Advisory Systems," Environmental Modelling & Software, vol. 150, p. 105365, 2022.
[17] J. Brown and M. Taylor, "Precision Agriculture Using IoT and Cloud Computing," IEEE Internet of Things Journal, vol. 8, no. 9, pp. 7100–7112, 2021.
[18] R. Patel and A. Sharma, "Explainable AI in Smart Agriculture," IEEE Access, vol. 11, pp. 45000–45015, 2023.
[19] H. Liu and X. Zhang, "Remote Sensing for Crop Monitoring," Remote Sensing, vol. 13, no. 18, p. 3654, 2021.
[20] M. Hassan and K. Rahman, "Artificial Intelligence for Precision Farming and Crop Advisory Systems,"
[21] Food and Agriculture Organization (FAO), "The State of Food and Agriculture 2024," Rome, Italy, 2024.
[22] Indian Council of Agricultural Research (ICAR), "Annual Report 2024," New Delhi, India, 2024.
[23] Ministry of Agriculture and Farmers Welfare, Government of India, "Annual Report 2024–25," New Delhi, India, 2025.
[24] National Bank for Agriculture and Rural Development (NABARD), "Annual Report 2024–25," Mumbai, India, 2025.
[25] Google, "Gemini API Documentation," 2025. [Online]. Available: https://ai.google.dev/gemini-api
[26] Google AI, "Google AI Studio Documentation," 2025. [Online]. Available: https://ai.google.dev/
[27] Supabase Inc., "Supabase Documentation," 2025. [Online]. Available: https://supabase.com/docs
[28] PostgreSQL Global Development Group, "PostgreSQL Documentation," 2025. [Online]. Available: https://www.postgresql.org/docs/
[29] OpenWeather Ltd., "OpenWeather API Documentation," 2025. [Online]. Available: https://openweathermap.org/api
[30] React Team, "React Documentation," 2025. [Online]. Available: https://react.dev/
[31] React Router Team, "React Router Documentation," 2025. [Online]. Available: https://reactrouter.com/
[32] Tailwind Labs, "Tailwind CSS Documentation," 2025. [Online]. Available: https://tailwindcss.com/docs
[33] Mozilla Foundation, "MDN Web Docs – JavaScript Guide," 2025. [Online]. Available: https://developer.mozilla.org/
[34] Vercel Inc., "Vercel Documentation," 2025. [Online]. Available: https://vercel.com/docs
[35] F. Pedregosa et al., "Scikit-learn: Machine Learning in Python," Journal of Machine Learning Research, vol. 12, pp. 2825–2830, 2011.
[36] S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Pearson, 2021.
[37] I. Goodfellow, Y. Bengio, and A. Courville, Deep Learning. Cambridge, MA, USA: MIT Press, 2016.
[38] Google Cloud, "Vertex AI Documentation," 2025. [Online]. Available: https://cloud.google.com/vertexai/docs
[39] Google Developers, "Geocoding API Documentation," 2025. [Online]. Available: https://developers.google.com/maps/documentation/geocoding
[40] World Bank, "Harvesting Prosperity: Technology and Productivity Growth in Agriculture," Washington, DC, USA, 2024.

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