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AI-BASED CROP DISEASE DETECTION AND MULTILINGUAL VOICE-ASSISTED FARMING SYSTEM

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ABSTRACT

The AI-Based Crop Disease Detection and Multilingual Voice-Assisted Farming System is developed to address challenges faced by farmers in identifying crop diseases and accessing timely agricultural guidance. Limited expert availability, language barriers, and lack of user-friendly digital tools often delay diagnosis and lead to crop losses. The proposed system provides an accessible and intelligent platform that enables early disease detection and advisory support through image-based analysis and conversational interaction.

The system utilizes a lightweight deep learning architecture, MobileNetV2, to automatically detect crop diseases from leaf images and generate advisory recommendations using a hybrid knowledge-driven approach. A multilingual voice interface integrated with speech-to-text and conversational processing allows farmers to interact with the system in Telugu, Hindi, and English, improving usability and inclusiveness. Additionally, contextual weather information is incorporated to enhance advisory relevance and support better crop management decisions.

The application is implemented using Streamlit, enabling seamless integration of AI models, advisory modules, and user interaction within a unified environment. Overall, the system offers a practical and scalable solution that promotes early disease identification, informed decision-making, and improved agricultural productivity through accessible AI-driven support.

I. INTRODUCTION

1.1 Overview

Agriculture plays an important role in supporting the economy and providing food security. Farmers often face problems such as crop diseases, lack of expert guidance, and unpredictable weather conditions. Identifying crop diseases at an early stage is difficult without proper technical support, which can lead to reduced yield and financial loss. In many rural areas, farmers also struggle to access agricultural experts and reliable information when needed.

With the development of Artificial Intelligence and Machine Learning, it is possible to build systems that assist farmers in diagnosing crop diseases and receiving advisory support instantly. Image-based disease detection models can help identify plant health issues, while conversational AI systems can provide treatment suggestions and preventive measures. Voice-based interaction and multilingual support can further improve accessibility for farmers who may not be comfortable with text-based interfaces.

The proposed system, AgriVision AI, is an intelligent agricultural advisory platform designed to assist farmers through multiple integrated features. The system uses a MobileNetV2 deep learning model trained on the PlantVillage dataset to detect crop diseases from leaf images. A hybrid chatbot provides advisory responses using structured agricultural knowledge, semantic retrieval, and controlled AI fallback. The system also includes a voice assistant, weather integration, multilingual support, and a Streamlit-based web interface.

Additionally, the platform incorporates user registration and database support to enable personalized access and data storage. The modular architecture of the system ensures scalability and easy integration of future agricultural intelligence features. Overall, AgriVision AI aims to provide timely, accessible, and reliable farming assistance to improve productivity and reduce crop losses.

In summary, AgriVision AI provides a unified and user-friendly platform that combines AI-based disease detection, intelligent advisory support, and accessible interaction features to help farmers make timely and informed agricultural decisions.

1.2 Motivation

Farmers often face challenges such as crop diseases, unpredictable weather, and limited access to expert guidance, which can affect productivity and income. Early disease detection and timely advisory support are important for improving crop health and reducing losses. Traditional advisory methods are often slow and not easily accessible.

Motivated by these challenges, AgriVision AI is developed to provide an intelligent agricultural advisory platform that combines AI-based disease detection, chatbot guidance, voice interaction, and weather insights. The system aims to help farmers make better decisions, improve productivity, and support sustainable farming practices.

1.3 Problem Definition

Farmers face major challenges such as crop diseases, unpredictable weather conditions, and limited access to timely agricultural guidance. Traditional methods of disease

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identification rely on manual inspection and expert consultation, which can lead to delayed diagnosis and improper treatment. This often results in reduced crop productivity, increased costs, and financial loss for farmers. Another significant issue is the lack of integrated digital solutions that combine disease detection, advisory support, and weather insights in a single platform. Many farmers also struggle with accessibility due to language barriers and limited digital literacy, making it difficult to use existing agricultural tools effectively. The absence of personalized recommendations and real-time support further affects decision-making in crop management.

To address these challenges, there is a need for an intelligent agricultural advisory system that can provide early disease detection, reliable farming recommendations, and accessible interaction through voice and multilingual support. Developing an integrated, user-friendly, and scalable solution that combines AI-based disease detection, chatbot assistance, and weather intelligence remains an important requirement in modern agriculture.

1.4 Objective of the Project

The primary objective of this project is to develop an intelligent agricultural advisory system that assists farmers in detecting crop diseases and receiving timely farming guidance through Artificial Intelligence. By leveraging deep learning for image-based disease detection, conversational AI for advisory support, and weather integration, the system aims to improve crop health while reducing risks associated with delayed diagnosis and improper treatment.

One key goal is to enhance crop productivity by enabling early disease identification using a MobileNetV2 model trained on the PlantVillage dataset. Additionally, the system promotes informed decision-making by providing reliable treatment suggestions through a hybrid chatbot, voice-based interaction for improved accessibility, and multilingual support for diverse users. The integration of personalized user access and database storage further supports continuous guidance and efficient farm management, contributing to sustainable and smart agricultural practices.

1.5 Limitations of the Project

Although AgriVision AI aims to provide intelligent agricultural assistance, certain limitations may affect its performance and real-world applicability. One major limitation is data dependency, as the disease detection model relies on trained datasets that may not fully represent real-field conditions such as lighting variations, background noise, or mixed disease symptoms. This can sometimes reduce prediction accuracy when images captured by farmers differ from training data.

Weather unpredictability is another challenge, as sudden climatic changes may affect crop health and advisory relevance despite system recommendations. Additionally, internet connectivity and device availability can limit accessibility for farmers in remote areas, especially when using features such as image upload, chatbot interaction, and voice assistance.

The chatbot advisory system, while designed with structured knowledge and controlled AI fallback, may occasionally provide generalized recommendations that do not fully capture region-specific farming conditions. Similarly, multilingual support and voice recognition accuracy may vary depending on accents, background noise, or language complexity.

Another limitation involves user adoption, as some farmers may prefer traditional practices and hesitate to rely on digital tools. Database dependency and data privacy considerations also require careful handling to ensure secure storage of user information.

Despite these constraints, the system provides a strong foundation for intelligent agricultural advisory services. Continuous dataset expansion, localized model improvements, and infrastructure enhancements can help overcome these limitations and improve system effectiveness in real-world farming scenarios.

II. LITERATURE SURVEY

The framework in Paper [1] proposed by Mohanty et al. introduced a deep learning approach for plant disease detection using the PlantVillage dataset. The study applied convolutional neural networks to classify crop diseases from leaf images and achieved high accuracy, showing the potential of AI-based disease identification for early crop protection.

Paper [2] presented by Too et al. conducted a comparative study of deep learning models such as MobileNet, VGG, and ResNet for plant disease classification. The study showed that lightweight models like MobileNet achieve good accuracy with lower computational requirements, making them suitable for real-time agricultural applications.

Paper [3] proposed by Patel et al. developed an intelligent agricultural chatbot that provides advisory information on crop management and disease treatment using natural language processing. The system improved accessibility to farming knowledge but lacked integration with disease detection models.

Paper [4] presented by Kumar et al. introduced a voice-enabled farming advisory system using speech recognition and text-to-speech technologies. The system improved usability for farmers with limited literacy, though it focused mainly on voice interaction without AI-based diagnosis.

Paper [5] proposed by Zhao and Guo developed an agricultural decision system based on big data analysis that integrates modules such as knowledge base and inference engine to support farming decisions using environmental data.

Paper [6] presented by Ramesh and Vydeki proposed a smart agriculture framework integrating IoT and AI for crop

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monitoring and advisory support. The system improved farming efficiency but lacked conversational and multilingual interaction features.

Paper [7] proposed by Sharma et al. applied transfer learning techniques for crop disease detection, achieving high classification accuracy, although the study focused primarily on disease classification without advisory recommendations.

Overall, the literature shows that existing research addresses individual components such as disease detection, chatbot advisory, voice interaction, and weather-based support. However, integrated solutions remain limited. The proposed system, AgriVision AI, combines these features into a unified platform to provide comprehensive agricultural assistance.

III. SYSTEM ANALYSIS

EXISTING SYSTEM

Traditional agricultural advisory systems mainly depend on manual field inspection, agricultural experts, and government extension services to diagnose crop diseases and provide farming guidance. Farmers often rely on personal experience or fragmented online information, which may not always be accurate or timely. Although some mobile applications and agricultural portals exist, they usually provide limited functionality and lack personalization, real-time disease detection, and interactive advisory support.

These systems typically operate without integration of AI-based disease detection, conversational advisory tools, or voice-enabled interaction, which restricts their effectiveness in supporting modern farming practices. Additionally, many platforms do not provide multilingual support, making it difficult for farmers from diverse regions to access information comfortably. Limited weather-based advisory and absence of personalized user data storage further reduce their usefulness in decision-making. As a result, farmers may face delays in disease identification, improper treatment selection, and inefficient resource utilization, ultimately affecting crop productivity and income.

DISADVANTAGES:

1. **Delayed Disease Diagnosis:** Farmers must wait for expert consultation, leading to late treatment and crop loss.
2. **Limited Accessibility:** Agricultural experts are not easily accessible in rural areas.
3. **Lack of Personalized Guidance:** Existing systems provide general recommendations rather than user-specific advice.
4. **No Integrated Disease Detection:** Absence of image-based AI models for accurate plant disease identification.
5. **Low Usability:** Text-heavy interfaces and language barriers reduce accessibility for farmers with limited digital literacy.
6. **Fragmented Information Sources:** Farmers depend on multiple platforms for disease detection, advisory, and weather updates.

PROPOSED SYSTEM

The proposed system, **AgriVision AI**, is an AI-based agricultural advisory platform designed to provide integrated farming assistance through multiple intelligent modules. The system uses a MobileNetV2 deep learning model trained on the PlantVillage dataset to detect crop diseases from leaf images, enabling early diagnosis and timely treatment. This helps farmers identify plant health issues quickly and take preventive actions before the disease spreads.

A hybrid chatbot provides advisory responses using structured agricultural knowledge, TF-IDF–based semantic retrieval, and controlled LLM fallback to ensure reliable and safe recommendations. The system also incorporates voice interaction using speech recognition and text-to-speech technologies, multilingual support for improved accessibility, and weather integration for location-specific farming insights. These features allow farmers to interact with the platform easily and receive guidance in a convenient manner.

This system improves accessibility, reduces dependency on manual expert consultation, and provides real-time, personalized farming guidance, offering a practical and intelligent alternative to traditional agricultural advisory methods. Overall, AgriVision AI aims to support better decision-making, reduce crop losses, and promote efficient and sustainable farming practices.

ADVANTAGES:

1. **Early Disease Detection:** The system uses deep learning to identify crop diseases from leaf images at an early stage, helping farmers take timely action and prevent crop loss.
2. **Instant Advisory Support:** The hybrid chatbot provides quick recommendations on disease management, preventive measures, and general farming practices without waiting for expert consultation.
3. **Improved Accessibility:** Voice interaction and multilingual support allow farmers from different regions and literacy levels to use the system easily.
4. **Personalized Guidance:** User registration and database integration enable storage of interaction history, allowing the system to provide more relevant and personalized recommendations.
5. **Weather-Based Insights:** Integration with weather APIs helps farmers make informed decisions related to irrigation, pesticide application, and crop management.
6. **Reduced Dependency on Experts:** The system minimizes reliance on manual field inspection by offering AI-based diagnosis and advisory assistance.

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7. **User-Friendly Interface:** The Streamlit-based web application is designed with a simple interface, making it easy for farmers with limited technical knowledge to interact with the system.
8. **Safe and Reliable Recommendations:** Controlled AI fallback and dosage sanitization ensure that advisory responses are reliable and safe for farmers to follow.

IV. MODULE DESCRIPTION

The AgriVision AI system is an intelligent agricultural advisory platform designed to assist farmers in crop disease diagnosis and decision-making through AI-driven modules. The system is divided into multiple integrated components that collectively provide accurate and accessible agricultural support.

A. Dataset Module

The dataset module includes image and textual agricultural data used for training and advisory generation. The PlantVillage dataset is utilized for training the crop disease detection model, containing labeled images of healthy and diseased leaves across multiple crop types. Additionally, a structured agricultural knowledge base stored in JSON format is used to support chatbot advisory responses related to crop diseases, treatment methods, and farming practices.

B. Crop Disease Detection Module (Deep Learning)

This module performs automated crop disease detection using a MobileNetV2 convolutional neural network with transfer learning. Farmers upload leaf images through the Streamlit interface, and the model extracts visual features such as color variations, lesions, and texture changes to classify diseases. The system outputs the predicted disease along with confidence score and provides treatment recommendations through the advisory module.

C. Hybrid Chatbot Advisory Module

The hybrid chatbot module provides agricultural advisory support through natural language interaction. The module operates using a three-stage decision pipeline consisting of rule-based JSON knowledge retrieval, TF-IDF semantic similarity matching, and controlled Large Language Model fallback. This approach ensures reliable, context-aware, and safe advisory responses while maintaining explainability and safety through dosage sanitization.

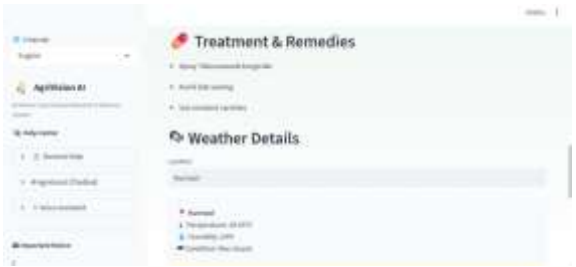
D. Voice Assistant Module

The voice assistant module enhances accessibility by enabling farmers to interact with the system using speech input. Voice queries are captured through microphone input and converted into text using the Whisper Tiny speech-to-text model. The converted text is then processed by the hybrid chatbot engine to generate advisory responses, enabling hands-free interaction in real-world agricultural environments.

E. User Interface Module

The user interface module is implemented using Streamlit to provide a simple and farmer-friendly interaction platform. The interface supports image upload for disease detection, text and voice-based chatbot interaction, multilingual support, and visualization of advisory outputs, ensuring usability across diverse farming communities.

V. OUTPUT SCREENS



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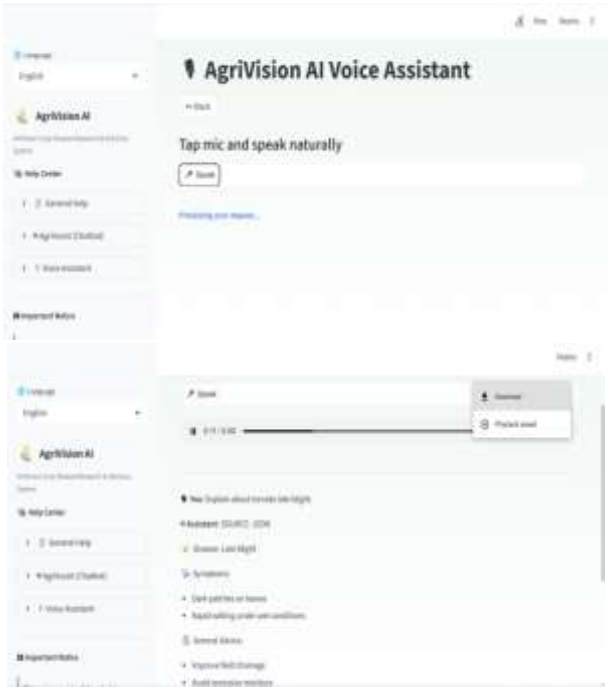

VI. CONCLUSION

Farmers often face challenges in identifying crop diseases at an early stage and accessing reliable advisory information for proper crop management. The AgriVision AI system addresses these challenges by providing an AI-based solution that detects crop diseases from leaf images and offers advisory support through a hybrid chatbot and voice interaction. The system uses a MobileNetV2 deep learning model for disease prediction, supported by a structured knowledge base and controlled AI insights to enhance guidance accuracy.

The developed system simplifies disease diagnosis, reduces dependency on expert consultation, and enables farmers to receive timely recommendations through a user-friendly interface. It also supports multilingual interaction and contextual weather information to improve decision-making. Overall, AgriVision AI contributes to improved crop health monitoring, faster advisory access, and enhanced agricultural productivity, demonstrating the potential of AI-driven tools in modern farming practices.

FUTURE ENHANCEMENTS

- Expansion of disease detection capability to include a wider range of crops and plant conditions.
- Integration of real-time pest detection and nutrient deficiency analysis.
- Offline functionality to support farmers in low-connectivity regions.
- Integration of real-time weather-based disease risk alerts to provide proactive preventive guidance for farmers.
- Continuous model improvement using larger and diverse agricultural datasets.

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