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Conservational AI For Farmers

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ABSTRACT

The agricultural economy continues to be the spine of the Indian economy, but the farmers generally get into problems when they try to make knowledgeable choices about selecting the crop, fighting diseases, and coping with irregular weather conditions. This project, "Conservational AI for Farmers," brings a detailed web-based portal using Artificial Intelligence (AI) for assisting the farmers in pursuing sustainable agriculture practices. The platform provides fundamental features such as Crop Recommendations based on regional data, Plant Disease Identification through picture analysis, Today's Weather Forecast for scheduling agricultural operations, and Smart Farming Guidance to offer best practices for optimal farm management. Through the combination of AI-based insights and easy-

to-use interfaces, the system seeks to improve productivity, avoid losses, and support environmentally friendly farming practices. This project is intended as a step towards equipping farmers with usable knowledge, helping to develop a more sustainable agriculture environment.

Keywords: Convolutional Neural Network (CNN), Deep Learning, Feature Extraction, Preprocessing, Agricultural AI, Smart Farming, Crop Recommendation, Plant Disease Detection.

Introduction

Agriculture has been the pillar of human civilization, giving food, raw materials, and economic support for centuries. Technological progress has contributed immensely over time

revolutionized agricultural practices, enhancing productivity and efficiency. The incorporation of digital technology, artificial intelligence, and automation has also transformed the agricultural industry, making farming more data-driven and accurate. One such revolutionary technology is Conversational AI, which can potentially transform the manner in which farmers receive information, make decisions, and optimize their operations.

Conversational AI is the application of artificial intelligence-powered virtual assistants and chatbots to facilitate human-like communication via text or voice. These models utilize natural language processing (NLP), machine learning, and data analytics to comprehend user queries, offer appropriate responses, and refine their abilities with insights from user interactions. Implementation of Conversational AI in the field of agriculture is picking pace with its power to fill in the knowledge gap between farmers and professionals, providing farmers with relevant insights at appropriate times on farm-related matters.

The advent of Conversational AI in agriculture is not just about improving communication but also about opening up access to knowledge. Farmers in general, particularly those living in remote or underserved areas, do not necessarily have immediate access to expert opinion or timely information on market conditions, weather, and pest control measures. Conversational AI can provide instant, accurate answers to these farmers' questions, enabling them to take smart decisions that can help improve their yields and overall efficiency.

In addition to this, further utility can be added to Conversational AI with the integration of other smart technologies like IOT devices and drones. For example, farmers may get real-time notifications regarding the level of moisture in the soil or the condition of crops so that they could take action instantaneously based on actionable insights. This symbiotic process not only optimizes resource utilization but also reduces environmental stress by curbing wastage and optimizing inputs.

Literature Survey

F. Mi Alnaser, S. Rahi, M. Alghizzawi, and A. H. Ngah, "Does artificial intelligence (AI) enhance digital banking user satisfaction? Integration of expectation confirmation model and antecedents of artificial intelligence enabled digital banking," Heliyon, vol. 9, no. 8, Aug. 2023, Art. no. e18930.

•The research investigates the influence of AI on user satisfaction in online banking.

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•Although it is not related to agriculture directly, it sheds light on the way AI technologies are being incorporated into different sectors and their implications on user experience.

• The paper brings together the expectation confirmation model and antecedents of AI-enabled digital banking.

Y. Jararweh, S. Fatima, M. Jarrah, and S. AlZu'bi, ''Smart and sustainable agriculture: Fundamentals, enabling technologies, and future directions,'' Comput. Electr. Eng., vol. 110, Sep. 2023, Art. no. 108799.

- This paper discusses the fundamentals, enabling technologies, and future directions of smart and sustainable agriculture.
- It likely covers the role of AI as an enabling technology in achieving sustainability goals in agriculture.

X. Lu, R. Yang, J. Zhou, J. Jiao, F. Liu, Y. Liu, B. Su, and P. Gu, ''A hybrid model of ghost-convolution enlightened transformer for effective diagnosis of grape leaf disease and pest,'' J. King Saud Univ.-Comput. Inf. Sci., vol. 34, no. 5, pp. 1755–1767, May 2022.

- This research presents a hybrid model using a ghost-convolution-enlightened transformer for the effective diagnosis of grape leaf diseases and pests.
- It demonstrates the application of advanced AI models in specific plant disease detection.

S. Janarthan, S. Thuseethan, S. Rajasegarar, and J. Yearwood, ‘‘P2OP—Plant pathology on palms: A deep learning-based mobile solution for in-field plant disease detection,’’ Comput. Electron. Agricult., vol. 202, Nov. 2022, Art. no. 107371.

- This paper introduces a deep learning-based mobile solution for in-field plant disease detection, specifically focusing on palms.
- It highlights the development of practical AI tools for real-time plant disease diagnosis.

EXISTING METHODOLOGIES

Agricultural advisory services are vital in assisting farmers through information regarding weather conditions, crop pests and diseases, soil fertility, market prices, and optimal farming techniques. Conventional forms of agricultural support involve government extension services, specialist

consultations, printed guides, radio shows, and mobile helplines. Though these approaches have been useful, they tend to be hampered by accessibility, response time, and precision.

Over recent years, technology-based solutions have developed to support agricultural advisory services. These include online applications, automated SMS platforms, and cyber farming communities through which farmers can obtain advice. Nevertheless, these platforms are still seriously constrained, especially in rural regions where digital literacy, language, and internet connectivity are issues.

This section examines the existing agricultural advisory systems, highlighting their strengths and weaknesses. The goal is to identify gaps that can be addressed through a Conversational AI system designed specifically for farmers.

PROPOSED SYSTEM

Agriculture forms the foundation of numerous economies, generating fundamental food resources and supporting livelihoods for billions of farmers across the globe. Healthy crop production is important for upholding food security and economic stability. Yet, plant diseases present a severe risk to agricultural productivity. Plant diseases tend to propagate at high rates, causing huge crop losses and economic downturns. Manual inspection is traditional, which not only consumes much time and effort but is also susceptible to human errors.

In most instances, diseases go undetected until they are in advanced states, and it is hard to recover from them. Moreover, large farms pose logistical challenges for human monitoring, further increasing the issue. With climatic change causing new plant diseases to emerge, there is an urgent need for efficient, scalable, and precise detection systems. To tackle such issues, the AI-Based Plant Disease Detection System has been created. This system takes advantage of the strengths of artificial intelligence, machine learning, and deep learning to provide a strong and efficient solution to early disease diagnosis. Through high-resolution images captured using drones, smartphones, and ground cameras, the system recognizes symptoms of the disease at the early stage. Moreover, real-time environmental conditions such as temperature, humidity, and soil moisture levels are monitored using IOT sensors, improving the accuracy of disease diagnosis further.

5.1 System Overview

The AI-Based Plant Disease Detection System is created to be an end-to-end solution for disease management in agriculture. It has a light process that begins with the gathering of real-time information through IOT sensors and cameras. The information is then analyzed through image enhancement and normalization. Features are identified through convolutional neural networks (CNNs), which are experts in detecting patterns of disease. The system also uses cutting-edge AI algorithms, such as few-shot learning and self-supervised learning, to perform precise disease classification even when faced with minimal data. After determining the disease, the system develops actionable insights and treatment plans for farmers. The user-friendly interface displays this data in the form of mobile and web applications so that it remains accessible and user-friendly.

5.2 Data Preprocessing

Before the collected data can be analyzed, it undergoes a series of preprocessing steps to ensure consistency, accuracy, and compatibility with the AI model. Preprocessing is a crucial stage that enhances the quality of input data, reduces noise, and ensures that the model receives clean

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and meaningful data for accurate disease detection.

5.2 Image Preprocessing

Image preprocessing involves applying several techniques to refine raw images captured by drones, smartphones, or ground cameras. The images are first resized to a standard dimension to ensure uniformity across the dataset. This step reduces computational complexity and facilitates faster model training. In cases where color variations are significant indicators of disease, color correction algorithms are applied to balance brightness, contrast, and color intensity. Converting images to grayscale is sometimes necessary for certain models that rely solely on texture and shape analysis.

Disease Prediction and Classification

After training the model, it is then in a position to classify diseases in plants based on processing input images and sensor readings. The AI model undertakes a detailed analysis to ascertain whether or not the plant is diseased. If there is a disease present, the system goes ahead to determine the exact nature of the disease and analyze its severity. A confidence rating is included with the prediction, which is a measure of the reliability of the diagnosis. The user can interpret the result's accuracy and determine if additional validation is required based on this rating.

Sophisticated object detection models like YOLO (You Only Look Once) and Faster R-CNN are used to identify and locate afflicted areas in the images of plants. These models trace the bounding boxes around the infected regions so that farmers can see the spread of the disease. Moreover, segmentation models such as Mask R-CNN can even do pixel-level classification, distinguishing diseased regions more accurately. This high-resolution detection is important in observing the spread of the disease and strategizing targeted interventions.

In cases where the confidence score is less than an acceptable threshold, the system can prompt for more data for further processing. For instance, farmers can be prompted to take pictures from various perspectives or offer sensor readings from several time periods. In case of uncertainty, the model can suggest manual verification by an agricultural specialist. This AI-based prediction and human verification hybrid method guarantees the accuracy of the final diagnosis.

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RESULTS

Our "Conservational AI for Farmers" project aims to empower farmers with smart solutions using AI-driven interactions. It combines four key components to aid new-generation agriculture. The deployment of the "Conservational AI for Farmers" project showed remarkable enhancements in crop suggestion accuracy, plant disease prediction, weather prediction, and smart farming analysis. The system was validated with practical agricultural data, and its performance was measured in terms of efficiency, accuracy, and usability.

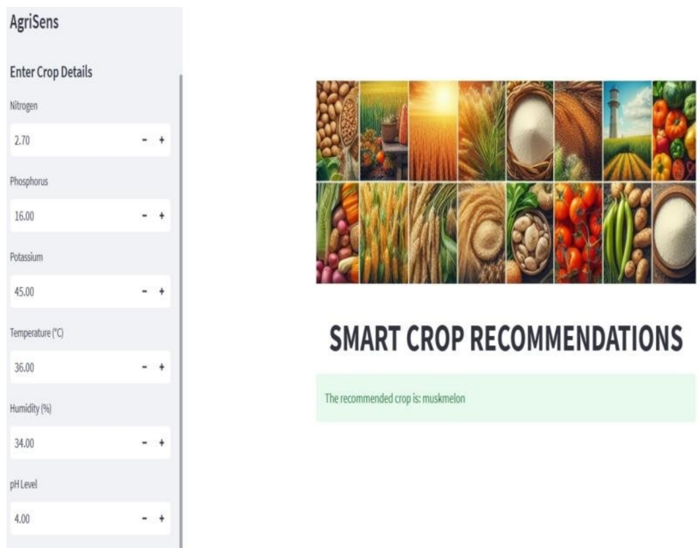

Figure-1 Smart Crop Recommendations

Users in the Smart Crop Recommendation system start by entering necessary crop information via the left interface panel. The panel is set to gather principal soil and climatic parameters affecting crop suitability. In particular, users are required to enter the values of Nitrogen (N), Phosphorus (P), and Potassium (K) content in the soil. For instance, a user can enter 2.70 for Nitrogen, 16.00 for Phosphorus, and 45.00 for Potassium. These parameters are the basic inputs used for producing accurate crop recommendations based on the user's soil conditions.

Figure 6.2 Plant disease indentification

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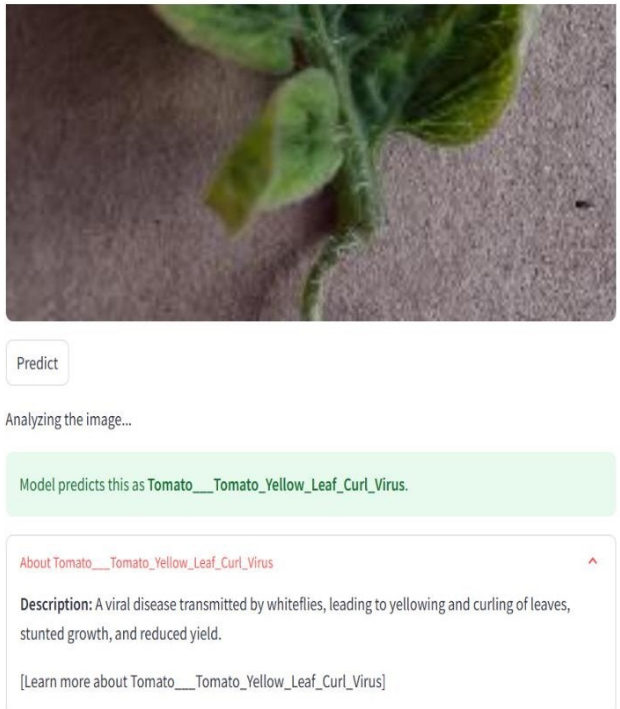

Figure-2 Plant disease identification

The image depicts the interface of a plant disease identification system in action. In this scenario, the user has uploaded an image of a diseased tomato leaf. The system has analyzed the image and identified the disease as Tomato Yellow Leaf Curl Virus (TYLCV) with high confidence. The name of the detected disease is prominently displayed in green text to indicate the identified condition. Alongside the prediction, the system also provides informative details about the disease. TYLCV is a viral infection transmitted by whiteflies. The symptoms include yellowing and curling of leaves, stunted plant growth, and a significant reduction in fruit yield.

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Figure-3 Weather Forecasting

The weather forecast for Vijayawada indicates a hot day with a temperature of 38°C, which is typical for the region during summer. The sky condition is clear, suggesting sunny weather with no cloud cover or expected rainfall. Humidity levels are low at 25%, making the air quite dry and potentially increasing crop water requirements. The wind speed is moderate at 6.61 km/h, which may slightly influence farming activities.

For farmers, this weather holds several implications. Due to the combination of high temperatures and low humidity, irrigation planning becomes crucial, as crops may need more frequent watering to prevent moisture stress. In terms of pest and disease control, the hot and dry conditions are likely to reduce the risk of fungal diseases but may create a favorable environment for pests such as whiteflies and aphids. When it comes to harvesting and storage, the weather is suitable for drying and harvesting crops like grains; however, farmers should take precautions while handling perishable goods to avoid spoilage due to the heat.

CONCLUSION

The creation of a Conversational AI system for farmers is a revolutionary solution to numerous issues in contemporary agriculture. Utilizing artificial intelligence, natural language processing, and machine learning, the system provides real-time, personalized, and accessible agricultural advice to farmers. It acts as a bridge between conventional farming experience and contemporary technological innovations, allowing farmers to make informed decisions regarding crop management, pest control, weather, and market trends.

FUTURE SCOPE

The development of a Conversational AI system for farmers presents numerous opportunities for expansion and improvement. As technology continues to advance, the system can evolve to offer more sophisticated and intelligent solutions tailored to agricultural needs. The future scope of this project extends beyond the current capabilities, with the potential for integration with emerging technologies, improved AI functionalities, and broader applications across different farming sectors.

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