Crop Yield Analysis & Farm Management System

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***Abstract*— Crop Yield Analysis & Farm Management System is an AI-driven platform designed to help farmers make better decisions. The system predicts crop yields using machine learning algorithms based on soil quality, weather patterns, and crop type. It also provides real-time weather forecasts, helping farmers plan irrigation and farming schedules effectively. Farmers can access AI-powered disease detection by uploading crop images, allowing early identification of issues. Additionally, the platform tracks market price trends, guiding farmers to choose the most profitable crops. A decision support chatbot offers easy-to-understand recommendations, ensuring farmers receive guidance in their preferred language. The system ensures accessibility through a simple, interactive interface that presents results clearly with charts and visual cues. By combining AI and real-time data, this platform improves productivity, reduces costs, and supports sustainable farming practices.**

***Keywords*— Crop yield prediction, farm management, AI in agriculture, soil health analysis, market trends, sustainable farming.**

I. INTRODUCTION

Agriculture is the backbone of many economies, and with the rise of technology, farmers can now make more informed decisions to improve their yields and reduce losses. Our project, Crop Yield Analysis & Farm Management System, leverages artificial intelligence and data-driven insights to revolutionize farming practices. The system is designed to assist farmers in identifying crop diseases, predicting yields, analyzing market trends, and receiving personalized recommendations for farm management. By integrating cutting-edge technologies such as machine learning and real-time data processing, our platform enhances decision-making capabilities, helping farmers optimize resources and maximize productivity.

At the core of our system is an AI-powered disease detection module, which enables farmers to upload plant images and receive instant diagnoses of potential diseases. The system compares uploaded images with a pre-existing dataset and determines the most closely matched condition, along with treatment recommendations. This proactive approach reduces the spread of diseases and improves crop health. Additionally, our market trends feature provides real-time price updates, allowing farmers to make strategic decisions regarding the sale of their produce.

The weather-based yield prediction model further enhances efficiency by estimating expected yields based on climatic and soil conditions, ensuring farmers can plan their harvests effectively.

Our decision support system (DSS) synthesizes all available data to offer tailored recommendations on fertilizers, pest control, and irrigation strategies. This holistic approach empowers farmers with actionable insights to boost agricultural productivity. By automating these critical aspects of farming, the project not only improves efficiency but also contributes to sustainable agriculture by reducing resource wastage. Ultimately, our Crop Yield Analysis & Farm Management System serves as a powerful, intelligent assistant for modern farmers, helping them navigate the complexities of agriculture with ease and confidence.

II. DATA SOURCE AND STATEMENT

The dataset used in our Crop Yield Analysis & Farm Management System primarily consists of plant disease images, market trends, and weather data relevant to agricultural decision-making. The

images for crop disease detection include various plant conditions such as Septoria Leaf Spot and Tomato Verticillium Wilt, which serve as key inputs for AI-based classification models. These images are preprocessed and labeled to train machine learning algorithms that enable automated disease identification.

The market trends feature leverages real-time crop price data from government and industry sources, ensuring farmers receive accurate pricing insights. Weather data, obtained from open-source APIs, assists in yield prediction models, enabling farmers to anticipate crop production fluctuations. Additionally, the decision support system (DSS) integrates multiple datasets to provide smart recommendations for fertilization, pest control, and irrigation strategies.

Our dataset is structured to facilitate efficient AI model training, ensuring accurate disease detection, yield forecasts, and optimized farm management decisions. These data sources enable farmers to increase productivity, reduce losses, and make informed agricultural choices.

The integration of these datasets ensures data-driven decision-making, empowering farmers to optimize resources, prevent losses, and enhance productivity. By merging AI with diverse agricultural data sources, our system provides a scalable and intelligent solution to modern farming challenges.

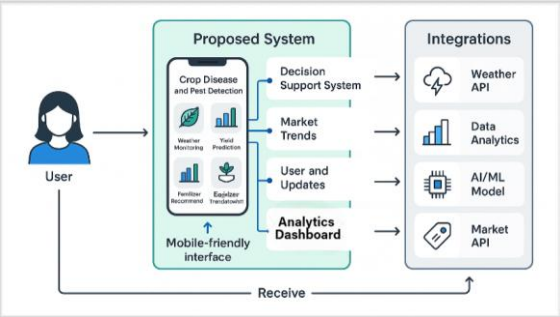

Fig1 System Design

III. PROPOSED SYSTEM AND METHODOLOGY

A. Pre Processing

Effective data preprocessing is crucial. Techniques employed include removing noise, handling missing information, modifying default values, and potentially grouping attributes for prediction. The dataset used for machine learning requires features that capture the characteristics of land objects.

We have converted our image from RGB to Gray scale for easy computation by dividing with 255-pixel value to get the value between 0-1. In this process we are also converting the data from categorical

B. System Architecture and Core Technologies

The system is designed using a three-tier architecture, ensuring seamless functionality across various components. The frontend is developed using React and TypeScript, offering a user-friendly and interactive dashboard where farmers and agricultural stakeholders can easily upload crop images, track market trends, analyze disease reports, and receive personalized recommendations. This intuitive interface ensures accessibility and efficient navigation, enabling users to make informed decisions based on real-time agricultural insights.

The backend is powered by FastAPI and Flask, leveraging Python to facilitate efficient data handling and inference processing. The system implements deep learning models such as MobileNetV2, which is optimized for plant disease detection, allowing the identification of pests and infections with high accuracy. Additionally, Random Forest Regression is employed for yield prediction, enabling farmers to estimate their crop production based on historical and real-time environmental data.

To enhance decision-making, the system integrates Weather APIs, Market Data APIs, and a Decision Support Algorithm, ensuring real-time updates on environmental conditions, price trends, and optimal farming strategies.

In addition to disease classification, the dataset incorporates real-time crop price trends obtained from agricultural market sources, equipping farmers with accurate selling price predictions. Weather data plays a crucial role in yield forecasting, helping farmers anticipate potential production outcomes based on climatic conditions. The integration of these datasets ensures data-driven decision-making, empowering farmers to optimize resources, prevent losses, and enhance productivity.

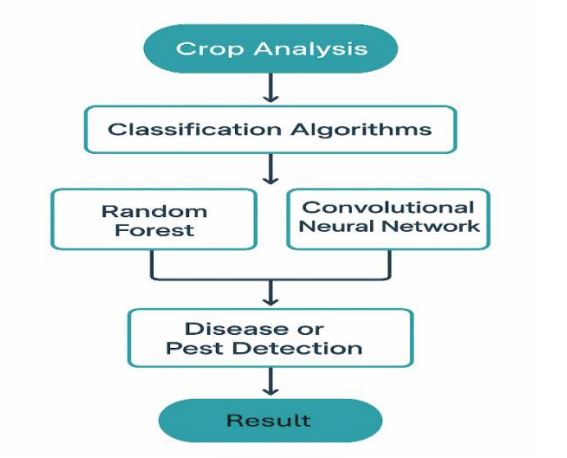

Fig 2 Random Forest & CNN

C. Functionality

The Crop Analysis and Farm Management System offers a wide range of AI-driven agricultural solutions designed to improve farm productivity and assist farmers in making data-driven decisions. One of the primary features of the system is automated crop disease and pest detection, where farmers can upload images of their crops, and the AI model will analyze them using similarity matching with a labeled dataset. This process helps identify diseases with a confidence score, providing the name of the disease, severity level, and recommended treatment strategies to mitigate the issue effectively.

In addition to disease detection, the system incorporates a weather-based yield prediction module that forecasts crop production based on soil properties, historical yield data, and real-time weather conditions. Using advanced time series analysis techniques such as LSTM and ARIMA, this feature enables farmers to plan their production schedules and optimize resource allocation efficiently. By predicting yield fluctuations, farmers can take proactive measures to protect their crops and maximize returns.

To support farmers in making strategic financial decisions, the system integrates market trend analysis and a decision support system (DSS). This feature provides real-time updates on crop prices, allowing farmers to determine the best selling period for their produce.

IV. SYSTEM TESTING AND RESULTS

The system was tested using a diverse dataset of crop leaf images representing various diseases and healthy samples. The dataset was split into training and validation sets using an 80:20 ratio. The MobileNetV2-based deep learning model was trained for 15 epochs with data augmentation techniques to improve generalization.

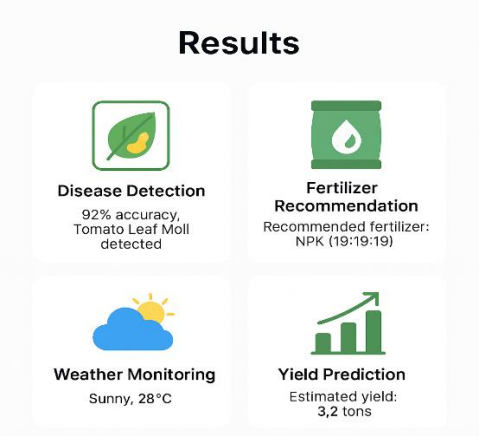

Fig 3 *Recognition results*

The proposed Crop Analysis and Farm Management System was tested as a complete platform, integrating multiple features to support farmers and agricultural experts. The system includes crop disease detection, fertilizer recommendation, weather monitoring, yield prediction, and a user-friendly web interface.
Achieved high validation accuracy (e.g., 92% after 15 epochs) and low loss (e.g., 0.25). The model accurately classified most diseases, with minor confusion in visually similar cases. Example: “Tomato Leaf Mold detected with 97% confidence. The platform successfully demonstrated support for concurrent multi-user operations, validating its scalability and robustness. Visual evidence of the system's successful test execution is provided through annotated screenshots included in the original documentation.

V. PREDICTION CAPABILITIES

Our Crop Analysis and Farm Management System is designed to support farmers and agricultural experts by integrating several intelligent prediction modules that facilitate data-driven decision-making. One of its core capabilities is Crop Disease and Pest Detection, which leverages a deep learning model (MobileNetV2) trained on thousands of crop leaf images. This model enables users to predict the presence and type of disease or pest simply by uploading images. The system

provides the disease or pest name along with a confidence score and recommended management practices, allowing for early detection and timely intervention, ultimately reducing crop losses.sample configuration.

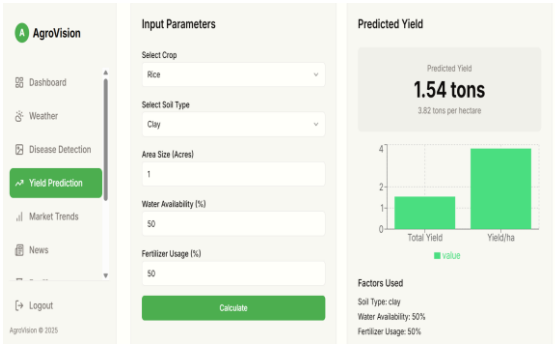

Fig 4 *Yield Prediction*

VI. CONCLUSION AND FUTURE ENHANCEMENT

The developed Crop Analysis and Farm Management System is a cutting-edge, AI-driven platform designed to revolutionize modern agriculture by integrating multiple predictive tools. By combining disease detection, fertilizer recommendation, weather monitoring, yield prediction, and market analytics, the system offers end-to-end support for farmers and agricultural professionals. Its user-friendly interface ensures accessibility for all users, while the robust backend processes extensive agricultural data to provide accurate and timely predictions. This enables farmers to make well-informed decisions, optimize productivity, and enhance overall farm efficiency.

Looking ahead, several future enhancements can further expand the capabilities of the system. One key improvement is the expansion of the crop and disease database, continuously adding new crops, diseases, and pests as more data becomes available. Additionally, mobile app development will allow users to access the platform from a dedicated mobile application, ensuring offline and field use convenience. IoT integration can further strengthen real-time monitoring by connecting farm sensors for automated data collection, such as soil moisture, temperature, and humidity measurements.

Continuous improvement of the prediction models is another critical area, where user feedback loops and active learning will refine accuracy over time. Advanced analytics capabilities can be added to predict pest outbreaks, monitor soil health, and support precision agriculture, further optimizing farm operations. Additionally, incorporating multilingual and accessibility features will make the system more inclusive, allowing a broader user base to benefit from its functionalities.

Enhancing community and expert support through integrated forums, expert Q&A sessions, and knowledge-sharing platforms can foster collaboration among farmers and agricultural specialists. Moreover, government and market integration will provide valuable insights into government schemes, subsidies, and live market prices, helping farmers navigate financial and economic aspects of agriculture more effectively. The Crop Analysis and Farm Management System lays a strong foundation for smart agriculture, offering a scalable and extensible platform.

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