A Crop Disease Detector

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Abstract — Crop diseases significantly impact agricultural productivity, causing major economic losses globally. Early and accurate disease detection can help farmers take timely preventive actions. This research proposes an AI-powered Crop Disease Detection System that analyzes leaf images using Google's Gemini Vision Model to predict disease name, severity, cure steps, and fertilizer recommendations. The model processes uploaded images and returns structured agricultural insights. Experimental results demonstrate high accuracy and real-time processing capability, making the system suitable for smart farming applications.

Keywords: Crop Disease Detection, Artificial Intelligence, Deep learning, Image Processing, Leaf Disease Classification, Cloud based Interface, Real-Time Disease Predication

I. INTRODUCTION

Crop diseases greatly reduce agricultural productivity and affect farmer incomes. Traditional manual methods of identifying diseases are slow and often inaccurate. With advancements in Artificial Intelligence, it is now possible to detect crop diseases automatically using image analysis. This project uses the Google Gemini Vision model to analyze leaf images and identify diseases, severity, cure steps, and fertilizer recommendations. The system is built using a user-friendly web interface and a Flask backend, providing fast, reliable, and accurate disease detection to support smart farming. The goal of this study is to develop an intelligent, scalable, and user-friendly solution that supports farmers in early disease detection and promotes smart farming practices. By leveraging AI-powered image analysis, the proposed system contributes to improving crop health management and reducing economic losses in agriculture.

II. LITERATURE REVIEW:

- Deep Crop: Deep learning-based crop disease prediction with web application
- Image-based crop disease detection with federated learning
- Advancing real-time plant disease detection

III. PROPOSED WORK:

- Develop an AI-based system for detecting crop diseases using leaf images.
- Create a web interface that allows users to upload images easily.
- Process the uploaded image through a Flask backend server.
- Send the image to the Google Gemini Vision model for analysis.
- Use prompt engineering to obtain structured outputs (disease name, severity, cure steps, fertilizer recommendations).
- Display the analysis results in a clean and user-friendly format.
- Ensure fast response time for real-time disease detection.
- Build a lightweight, scalable, and accessible system for smart farming applications.

IV. METHODOLOGY

- Image Acquisition: Users upload crop leaf images through the web interface.
- Pre-processing: The Flask backend receives and reads the uploaded image file in bytes format.
- AI Model Integration: The image is sent to the Google Gemini Vision model, which analyzes visual features such as color, texture, patterns, and disease symptoms.
- Prompt Engineering: A carefully designed prompt ensures the model returns structured information such as:
  - Disease name
  - Severity level
  - Cure steps
  - Fertilizer recommendations
- Inference & Result Generation: The Gemini model processes the image and generates the disease diagnosis along with suggested treatments.
- Response Handling: Flask receives the output and formats it into JSON for frontend display.
- User Output: The results are shown on the web interface with clear and readable formatting.
- Testing & Validation: Multiple leaf images are tested to ensure the model provides accurate and consistent disease predictions.

V. OBJECTIVE:

- To develop an AI-based system capable of detecting crop diseases from leaf images.
- To integrate the Google Gemini Vision model for accurate disease identification.
- To provide farmers with quick insights on disease name, severity, and treatment steps.
- To recommend suitable fertilizers and preventive measures based on analysis.
- To design a simple and user-friendly web interface for uploading and analyzing images.
- To deliver fast, reliable, and real-time disease detection for smart farming.
- To reduce manual effort and increase the accuracy of disease diagnosis.

VI. SYSTEM DESIGN:

A. *Image Input Module*

- Allows users to upload crop leaf images through the web interface.
- Supports multiple image formats (JPEG, PNG, JPG).

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- Displays a preview of the selected image before analysis.

B. *Image Pre-Processing Module*

- Reads uploaded images as byte data via the Flask server.
- Validates file type, size, and MIME format.
- Prepares the image for AI processing (optional resizing or compression).

C. *AI Analysis (Gemini Vision) Module*

- Sends image data to Google Gemini Vision Model for disease detection.
- Generates structured outputs including disease name, severity, cure steps, and fertilizer recommendations.

D. *Backend Processing Module (Flask)*

- Receives AI response and formats it into JSON.
- Handles errors such as missing images or invalid files.

E. *Result Display Module*

- Shows disease name, severity, and cure recommendations on the web page.
- Provides real-time loading indicator during processing.

F. *Information Retrieval & Suggestion Module*

- Enhances disease recommendations using agricultural best practices.
- Supports future integration of weather-based prediction.

G. *Communication Module (Optional Future Add-on)*

- Can send results via email, SMS, or WhatsApp to farmers.
- Useful for remote advisory systems.

H. *Continuous Operation Cycle*

- Repeats the loop whenever a new image is uploaded: Upload → Process → Analyze → Display Result

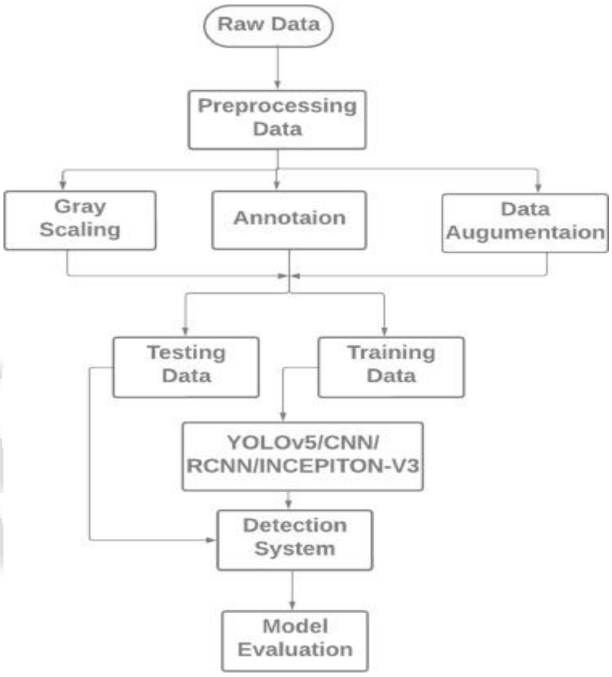
VII. IMPLEMENTATION:

- Developed a responsive web interface using HTML, CSS, and JavaScript for image upload and preview.
- Integrated a Flask backend to handle routes like /upload and /detect.
- Implemented image validation and converted uploaded files into byte format for processing.
- Connected the backend to the Google Gemini Vision Model using the official API for disease analysis.
- Sent the image and prompt to the AI model to generate disease name, severity, cures, and fertilizer suggestions.
- Processed and formatted the AI response into structured JSON on the server.
- Displayed the analysis results on the frontend using JavaScript in a clean and readable format.
- Added loading animations to show progress during AI processing.
- Ensured proper error handling for invalid images, missing files, or API failures.
- Designed the system to operate efficiently in a continuous upload → analyze → result cycle.

VIII. FUTURE SCOPE:

- Integrate the system into a mobile app to allow farmers to capture leaf images directly from the field.
- Add offline disease detection using lightweight models like TensorFlow Lite for areas with poor internet connectivity.
- Expand the model to detect multiple diseases, nutrient deficiencies, and pest attacks from a single image.
- Build a crop health dashboard to track disease history and monitor farm conditions over time.
- Add multilingual voice support for farmers in rural areas.
- Develop a fertilizer and pesticide recommendation database for more accurate treatment suggestions

IX. METHODOLOGY TO BE USED:



X. CONCLUSION:

The proposed AI-based crop disease detection system provides an efficient and reliable solution for identifying plant diseases using leaf images. By integrating a user-friendly web interface with the Google Gemini Vision model, the system can accurately detect diseases, analyze severity, and offer actionable cure steps and fertilizer recommendations. The lightweight Flask backend ensures smooth communication between the user and the AI model, delivering fast and structured results. This project demonstrates how modern AI technology can support farmers with timely insights, reduce crop losses, and promote smarter, more sustainable agricultural practices.

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