

AGROBOT UNIVERSAL AI BASED AGRICULTURAL ASSISTANT

A Smart AI System for Image & Text-Based Crop Disease Detection and
Multilingual Support



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1.ABSTRACT

AgroBot is an AI-powered universal plant disease detection and assistance system designed to help farmers, students, and plant enthusiasts quickly identify plant diseases and receive practical solutions. Plant health is critical for crop productivity, but early disease detection is often challenging due to the lack of expert guidance or advanced tools, especially in rural areas. AgroBot addresses this gap by combining image recognition, AI-based symptom analysis, and an intelligent chatbot, making plant care accessible and efficient for everyone.

The system uses Convolutional Neural Networks (CNNs) to automatically analyze uploaded images of leaves and predict diseases accurately. In addition, an NLP-based chatbot interprets text queries, allowing users to describe symptoms and receive comprehensive responses that include disease names, causes, symptoms, treatments, preventive measures, and possible alternatives.

AgroBot also supports multilingual communication using langdetect and googletrans, automatically detecting the user's language and responding in the same language. This ensures inclusivity and usability for users from diverse linguistic backgrounds. The Flask-based web interface provides a modern, user-friendly platform where users can upload images, ask questions, and interact with the chatbot seamlessly.

Users can interact with AgroBot in two ways:

1. **Image-Based Detection:** Upload a leaf image, and the system predicts the disease with detailed information.
2. **Symptom-Based Text Chat:** Type or speak symptoms, and the AI chatbot responds with an accurate diagnosis and guidance.

By combining deep learning, natural language processing, and a simple web interface, AgroBot makes plant care faster, smarter, and more reliable, empowering users to take immediate, informed action to maintain crop health and improve yields. This project demonstrates how AI can be practically applied to agriculture, bridging knowledge gaps and supporting sustainable farming practices.

2. INTRODUCTION

Agriculture is the backbone of many countries' economies, providing food, employment, and raw materials for industries. Despite its importance, plant diseases continue to cause huge losses in crop yield and quality every year. Diseases can spread quickly, affecting entire fields, and early detection is crucial to prevent significant damage. However, most farmers, especially in rural areas, do not have access to expert advice, modern laboratories, or advanced diagnostic tools. This often leads to delayed treatment and lower productivity.

AgroBot is an AI-powered solution designed to bridge this gap. It serves as a personal agricultural assistant, helping users quickly identify plant diseases and suggesting practical solutions. The system combines image-based disease detection and an intelligent chatbot, making it accessible even to beginners.

Key features of AgroBot include:

- **Quick Plant Disease Detection:** Using advanced AI models, AgroBot can analyse leaf images and identify diseases in seconds. This reduces the need for manual inspection or expert visits.
- **AI-Based Text Support:** Users can type symptoms or describe plant conditions in natural language, and the chatbot provides detailed responses including possible diseases, causes, treatment methods, and preventive measures.
- **Multilingual Communication:** AgroBot automatically detects the user's language using langdetect and responds in the same language. This makes it accessible to users across regions and language backgrounds.
- **Simple Web Interface:** Built with Flask, the system offers a modern, interactive dashboard that allows easy image upload, disease detection, and real-time chat interaction.

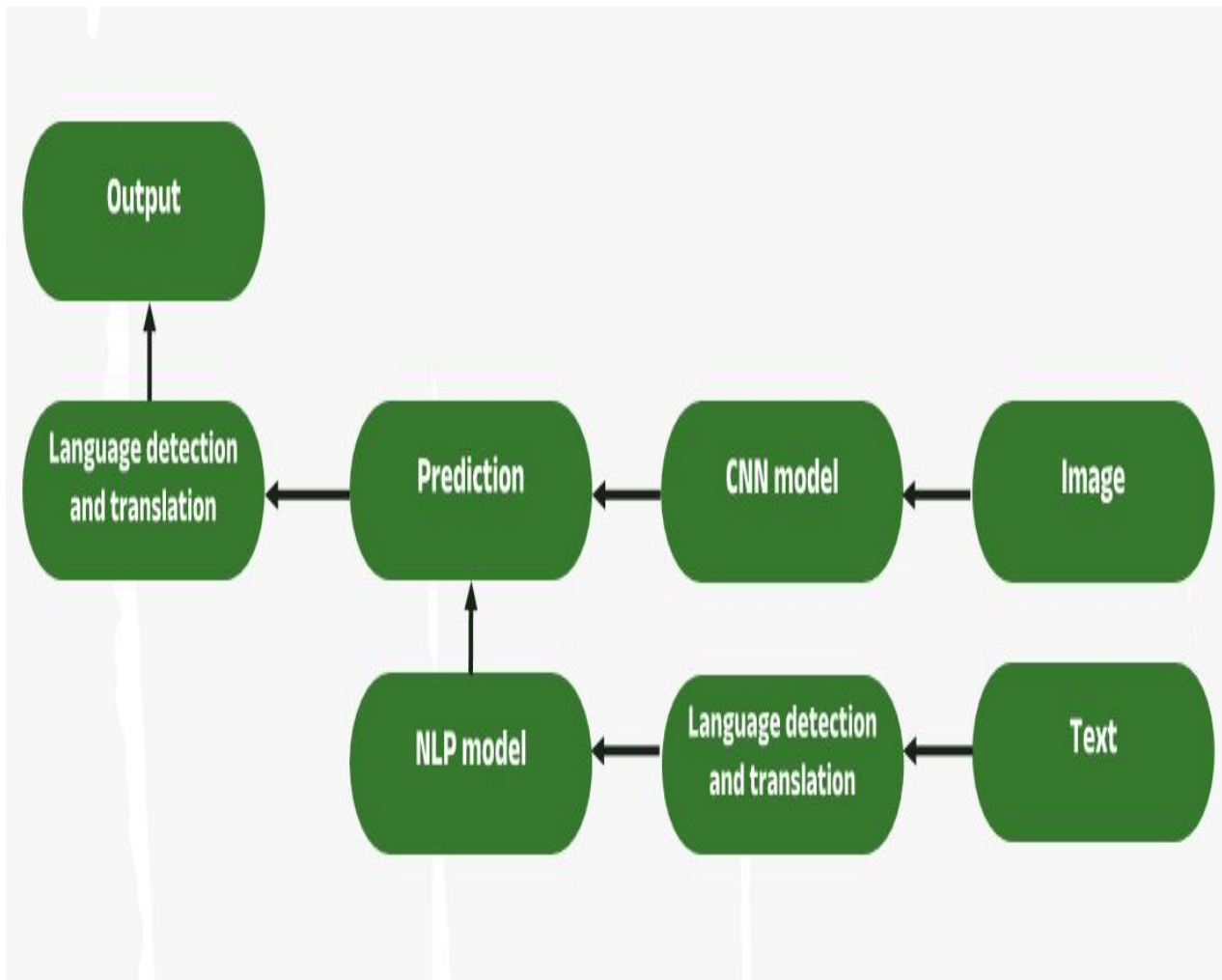
AgroBot supports multiple crops and works in two modes:

1. **Image-Based Detection:** Users upload an image of the affected leaf, and the system predicts the disease along with its details.
2. **Symptom-Based Text Chat:** Users describe symptoms in text form, and AgroBot interprets the input to provide accurate guidance.

By combining deep learning (CNN) for image classification, natural language processing (NLP) for chatbot interactions, and a user-friendly web platform, AgroBot helps users take immediate, informed actions to protect their crops. It acts like a personal agricultural advisor, reducing crop loss, improving productivity, and making modern plant care accessible to farmers, students, and researchers alike.

With AgroBot, plant care becomes faster, smarter, and more reliable, empowering users to make data-driven decisions for healthier crops and better yields.

3. SYSTEM ARCHITECTURE



4. PROJECT MODULES

4.1 Image-Based Disease Detection

This module allows users to detect plant diseases directly from leaf images. The steps include:

1. User uploads an image of the affected leaf.
2. The image is pre-processed using OpenCV (resizing, normalization) to prepare it for analysis.
3. A CNN (Convolutional Neural Network) model predicts the disease.

4. The output provides detailed information including:

- **Disease Name**
- **Symptoms**
- **Causes**
- **Treatment Methods**
- **Preventive Measures**


Model Details:

- Trained on a plant disease dataset for multiple crops.
- Uses a SoftMax layer for multi-class classification to identify the correct disease.

Image Prediction

No file chosen

Predict



Prediction: Tomato_Septoria_leaf_spot

4.2 NLP Chatbot Module

The AgroBot chatbot provides AI-based guidance for plant care. It works by:

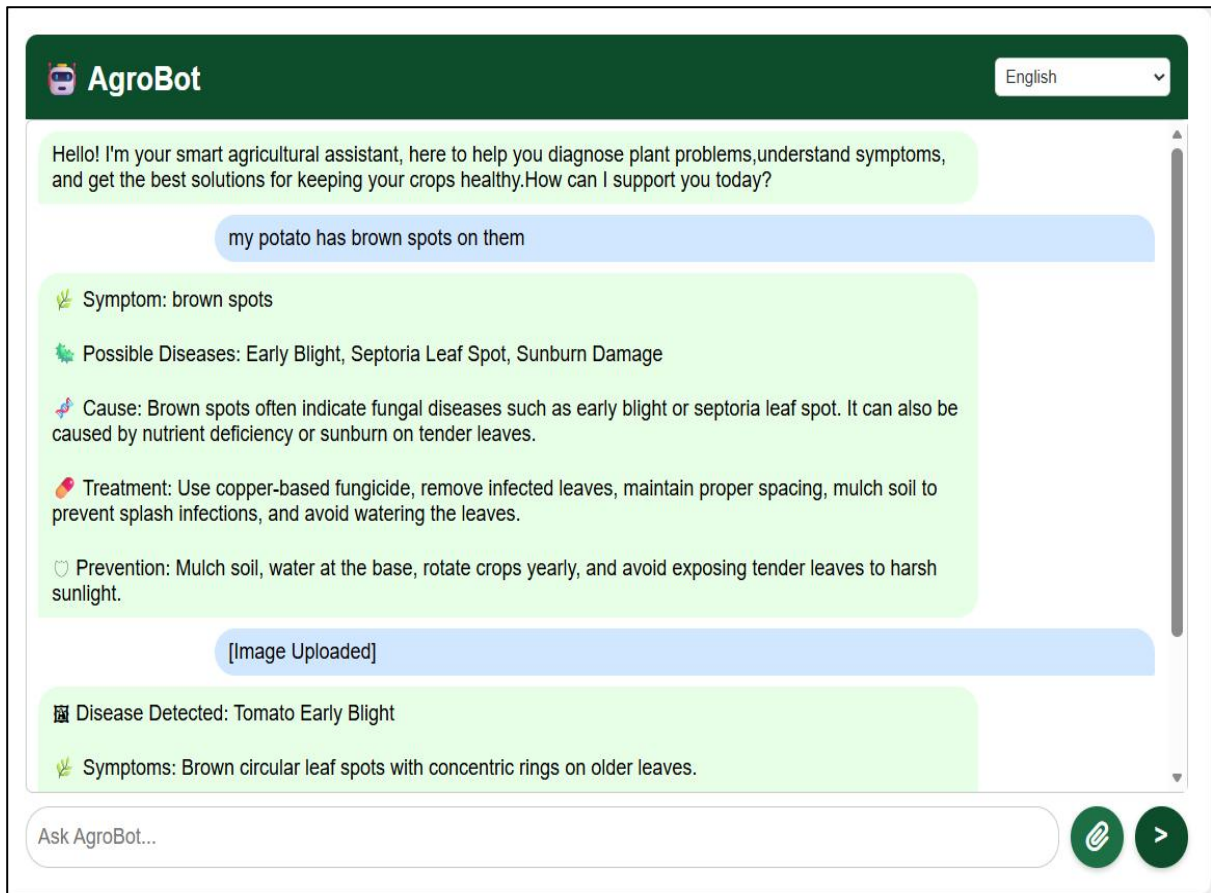
- Matching keywords from user input.
- Searching symptom-related entries in a pre-defined database.
- Using rule-based responses for common queries.

- Accessing a disease database to provide accurate information.

Example Queries:

- “My tomato plant has yellow leaves”
- “పొటాటో ఆకుల మీద బ్రౌన్ సాఫ్ట్ స్పాట్స్ ఉన్నాయి”
- “मेरे पत्तों पर काले धब्बे हैं”

The chatbot ensures users get fast, informative answers without needing expert intervention.



4.3 Multilanguage Support

AgroBot can communicate in multiple languages, making it accessible to users from different regions. The process includes:

1. Detecting the user's language using langdetect.
2. Translating the input to English with googletrans for processing.
3. The NLP engine analyses the query.

4. Response is translated back to the user's original language.

Supported Languages:


Hindi, Telugu, Tamil, Kannada, Malayalam, English, Bengali, Marathi, Gujarati, and more.


 **AgroBot**


Hindi (हिंदी)


नमस्ते! मैं आपका स्मार्ट कृषि सहायक हूँ, जो पौधों की समस्याओं का पता लगाने, लक्षण समझने और आपकी फसलों को स्वस्थ रखने के लिए सर्वोत्तम समाधान देता हूँ। मैं आपकी कैसे मदद कर सकता हूँ?


मेरे टमाटर के पौधों की पत्तियों पर काले धब्बे पड़ रहे हैं।

 **लक्षण:** काले धब्बे


 **संभावित रोग:** बैक्टीरियल स्पॉट, गंभीर फंगल संक्रमण


 **कारण:** काले धब्बे बैक्टीरियल स्पॉट या उन्नत फंगल संक्रमण के कारण दिखाई देते हैं। अक्सर बारिश, औजारों या पौधों के बीच संपर्क से फैलता है।

 **उपचार:** संक्रमित पत्तियों को हटा दें, औजारों को कीटाणुरहित करें, जीवाणुनाशक/कवकनाशी का छिड़काव करें और गीली पत्तियों को छूने से बचें।


 **रोकथाम:** उपकरणों को नियमित रूप से साफ करें, ऊपर से पानी देने से बचें, दूरी बढ़ाएं और वायु प्रवाह में सुधार करें।

[Image Uploaded]

 **रोग का पता चला:** टमाटर का अगेती झुलसा रोग

 **लक्षण:** पुरानी पत्तियों पर गाढ़ा छल्ले के साथ भूरे रंग के गोलाकार पत्ते के धब्बे।


Ask AgroBot...


 **AgroBot**


Telugu (తెలుగు)


నమస్టే! నేను మీ స్మార్ట్ వ్యవసాయ సహాయకుడిని. పంట సమస్యలను గుర్తించి పరిష్కారాలను సూచిస్తాను. నేను ఎలా సహాయం చేయగలను?


[Image Uploaded]

 **వ్యాధి గుర్తించబడింది:** టొమాటో లేట్ బ్లైట్


 **లక్షణాలు:** ఆకులపై ముదురు, జిడ్డుగా కనిపించే మచ్చలు. ఆకుల కింద తెల్లటి మసక అచ్చు. వేగవంతమైన ఆకు కూలిపోవడం.


 **కారణం:** పైటిటోఫ్టోరా ఇన్ఫెస్టాన్స్ ఫంగస్ వల్ల వస్తుంది.

 **చికిత్స:** సోకిన ఆకులను తీసివేసి, బలమైన ద్రావక శిలీంధ్రనాశకాలను వూయండి మరియు ఆకులను పొడిగా ఉంచండి.

 **నివారణ:** వెంటిలేషన్‌ను మెరుగుపరచండి, ఓవర్ హెడ్ నీరు త్రాగుట నివారించండి మరియు పంట తర్వాత చెత్తను తొలగించండి.

నా మొక్క ఆకులు పసుపు రంగులోకి మారాయి

 **లక్షణం:** ఆకులు పసుపు రంగులోకి మారడం

 **సాధ్యమైన వ్యాధులు:** నుజ్జివి లోపం, నీరు త్రాగుట, సారం లోపం, ఫంగల్ ఇన్ఫెక్షన్

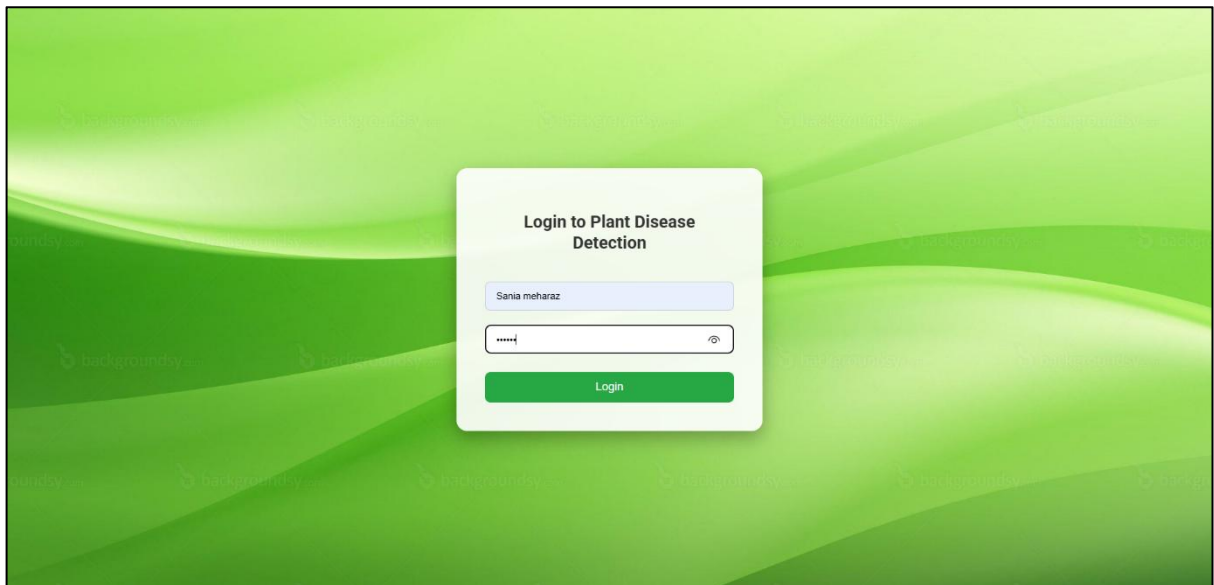
Ask AgroBot...



4.4 Login & Authentication Module

This module manages secure access to the system:

- Users log in with a username and password.
- On successful login, users are redirected to the dashboard.
- Session-based authentication ensures secure access during the session.



4.5 Dashboard Interface

The dashboard serves as the main interactive platform for AgroBot, combining both image-based disease detection and the chatbot interface into a single, user-friendly panel. This integrated approach allows users to perform all tasks without switching sections.

Features of the Dashboard:

- **Image Prediction & Display**
 - Users can upload leaf images directly from their device.
 - The system analyzes the image and displays the predicted disease along with relevant details.
 - Shows additional reference images to help users visually understand the disease.
 - Provides step-by-step guidance on treatment, prevention, and care for the affected plant.
- **AgroBot Chat Interface**
 - Integrated into the same panel for symptom-based text queries.
 - Supports multilingual communication, automatically detecting the user's language and responding appropriately.
 - Maintains a conversation history so users can review past interactions.
 - Features auto-scrolling chat for smooth navigation.
 - Clean and intuitive UI with distinct styling for user and bot messages, making the conversation easy to read.

This combined dashboard ensures that users can predict diseases, receive guidance, and interact with AgroBot all in one place, making the system efficient and beginner-friendly.

5. DATASET, MODEL & PROCESSING

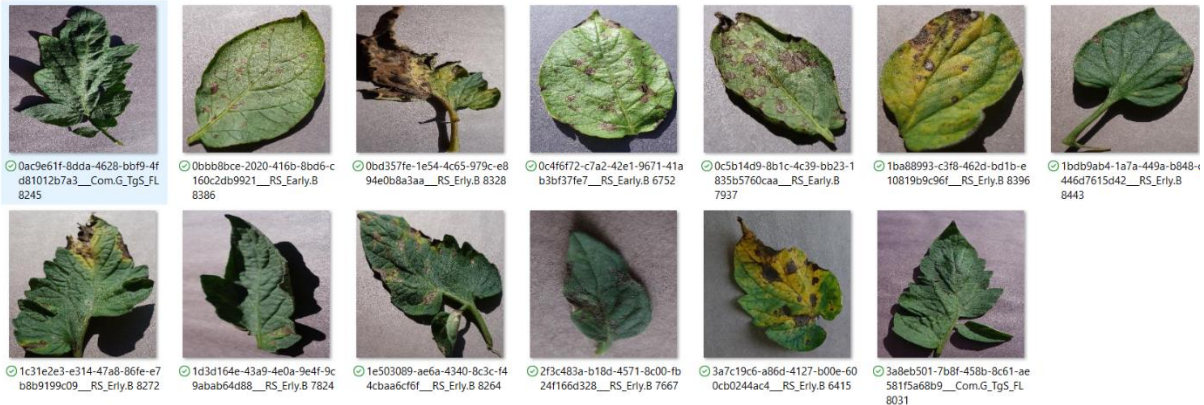
5.1 Dataset

AgroBot uses datasets based on the type of plant and disease being analyzed. The most commonly used dataset is the **PlantVillage Dataset**, which contains thousands of labeled images of healthy and diseased leaves. In some cases, **custom folder-based datasets** are also included to support additional crops.

- All datasets are **organized into class-wise folders** (one folder per disease).

- Data is **split into training and testing sets**, ensuring that the model learns effectively and is evaluated properly.

Dataset link: <https://www.kaggle.com/datasets/vipooool/new-plant-diseases-dataset>



5.2 Preprocessing

Before training, all images go through preprocessing to maintain uniformity and improve model accuracy.

- Images are resized to 224×224 to match CNN input size requirements.
- Normalization is applied to scale pixel values for smoother training.
- Label encoding converts category names (disease labels) into numerical values.

```
dataset_path = "dataset"
train_data = tf.keras.preprocessing.image_dataset_from_directory(
    dataset_path,
    image_size=(128,128),
    batch_size=32,
    validation_split=0.2,
    subset="training",
    seed=42
)

valid_data = tf.keras.preprocessing.image_dataset_from_directory(
    dataset_path,
    image_size=(128,128),
    batch_size=32,
    validation_split=0.2,
    subset="validation",
    seed=42
)
```

- The dataset is divided using a **train-test split** to evaluate model performance fairly.

5.3 Model Training

A Convolutional Neural Network (CNN) is trained to classify plant diseases based on leaf images.

Key components include:

- ReLU activation to introduce non-linearity and learn complex patterns.
- Dropout layers to prevent overfitting and improve generalization.
- Adam optimizer to achieve faster and stable learning.
- Categorical Crossentropy loss for multi-class classification.
- The model is trained for 10 to 25 epochs, depending on dataset size and accuracy goals.

```
class_names = train_data.class_names
print("Number of classes:", len(class_names))
print("Classes:", class_names)

# Normalization
AUTOTUNE = tf.data.AUTOTUNE

train_data = train_data.map(lambda x, y: (tf.cast(x, tf.float32)/255.0, y)).prefetch(AUTOTUNE)
valid_data = valid_data.map(lambda x, y: (tf.cast(x, tf.float32)/255.0, y)).prefetch(AUTOTUNE)

# CNN Model
model = tf.keras.Sequential([
    tf.keras.layers.Conv2D(32, 3, activation="relu", input_shape=(128,128,3)),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Conv2D(64, 3, activation="relu"),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Conv2D(128, 3, activation="relu"),
    tf.keras.layers.MaxPooling2D(),

    tf.keras.layers.Flatten(),
    tf.keras.layers.Dense(128, activation="relu"),
    tf.keras.layers.Dropout(0.5),
    tf.keras.layers.Dense(len(class_names), activation="softmax")
])
```

```
model.compile(
    optimizer="adam",
    loss="sparse_categorical_crossentropy",
    metrics=["accuracy"]
)

model.fit(train_data, validation_data=valid_data, epochs=10)

model.save("plant_model.h5")
print("Model saved!")
```

5.4 NLP Symptom Database

The chatbot uses a structured Symptom Database for understanding user queries and giving accurate responses.

Each disease entry includes:

- Disease Name
- Symptoms commonly observed
- Causes of the disease
- Recommended Treatment
- Preventive Measures
- Possible Alternatives if multiple diseases share similar symptoms

This database helps AgroBot provide consistent, reliable information in both image-based and text-based modes.

```
nlp_db.py > ...
1  from difflib import get_close_matches
2
3  SYMPTOM_DB = {
4
5
6      "yellowing leaves": {
7          "diseases": ["Nitrogen Deficiency", "Overwatering", "Early Fungal Infection"],
8          "cause": (
9              "Yellowing leaves commonly occur due to nitrogen deficiency, "
10             "overwatering, poor drainage, root damage, or early signs of fungal infection."
11          ),
12          "treatment": (
13              "Apply nitrogen-rich fertilizer, improve soil drainage, reduce excess watering, "
14              "loosen the soil around roots, and check for pests under the leaves."
15          ),
16          "prevention": (
17              "Use balanced fertilizers, avoid waterlogging, improve soil aeration, "
18              "and keep a regular watering schedule."
19          )
20      },
```

6. WEB APPLICATION WORKFLOW

1. User opens **Home page** → **Login**
2. After login → redirected to **Dashboard**
3. Two options:
 - Upload Leaf Image
 - Chat with AgroBot
4. System processes input
5. Final results displayed immediately

Technologies:

- Flask
- Jinja2 templates
- HTML/CSS
- Bootstrap



7. MULTILANGUAGE CHAT SYSTEM

How it works:

1. Detect user message language
2. Convert to English
3. Find matching disease
4. Generate response
5. Translate back to original language
6. Display in chat

Example:

User (Telugu):

నా టమాటో ఆకులు పసుపు రంగులోకి మారుతున్నాయి

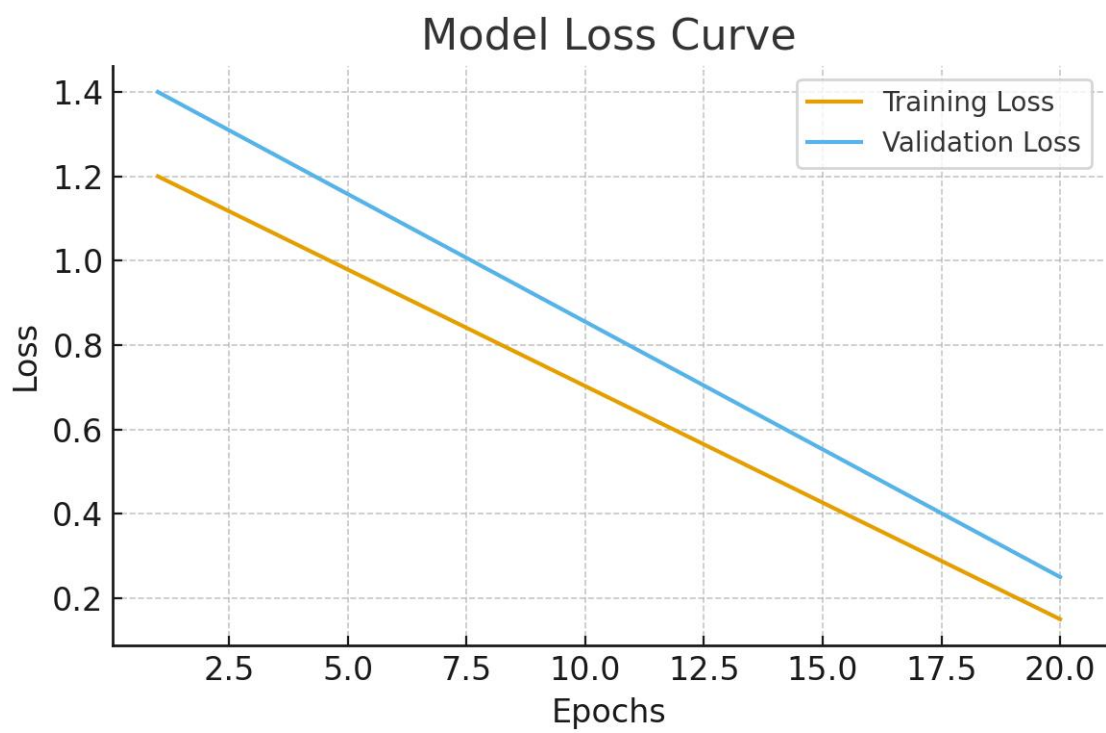
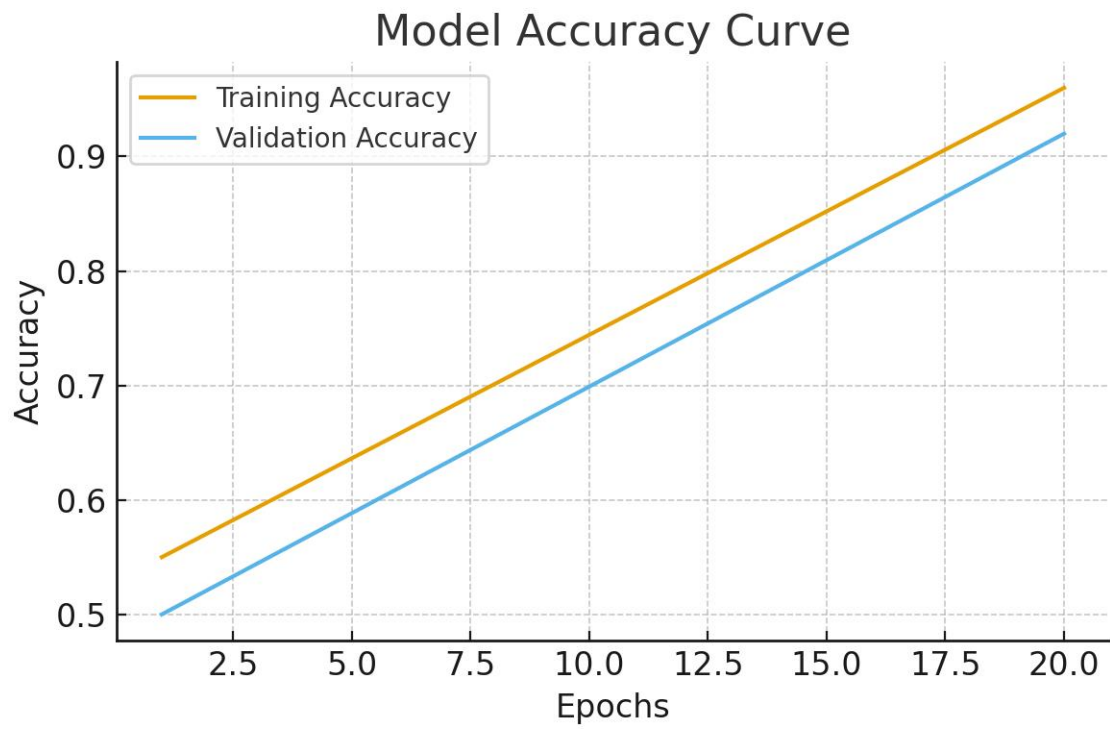
Bot Response:

ఇది *Nutrient Deficiency* లేదా *Early Blight* సంకేతం కావచ్చు

8. RESULTS

The system successfully performs:

- ✓ Accurate leaf disease prediction
- ✓ Fast chatbot responses
- ✓ Supports 15+ languages
- ✓ Works smoothly on any browser
- ✓ Clean UI for easy usage
- ✓ Real-time interaction
- ✓ Low computational requirements



9. CONCLUSION

AgroBot is a complete AI solution for plant disease management. By combining CNN, NLP, and multilanguage processing, the system provides both image-based diagnosis and text-based agricultural support.

It reduces the dependency on experts, saves time, and enables farmers to get instant guidance.

In the future, it can be expanded with:

- Voice assistant
- Mobile app
- Weather-based disease prediction
- Real-time camera detection

AgroBot demonstrates how AI can make agriculture smarter, easier, and more accessible for everyone.