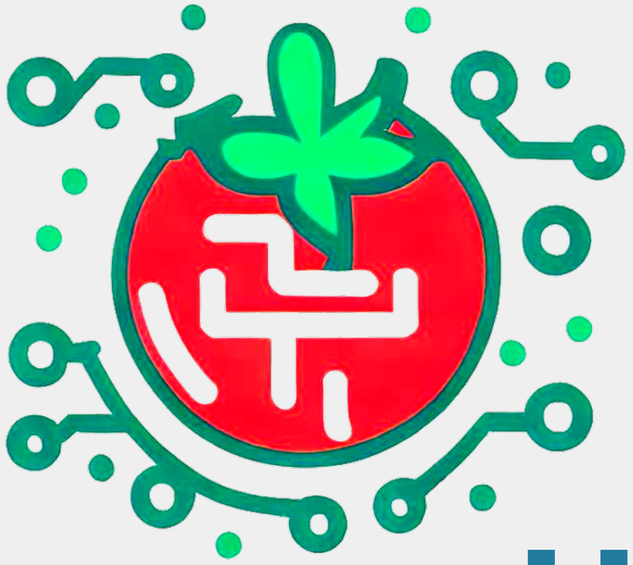
LEAFSENSE

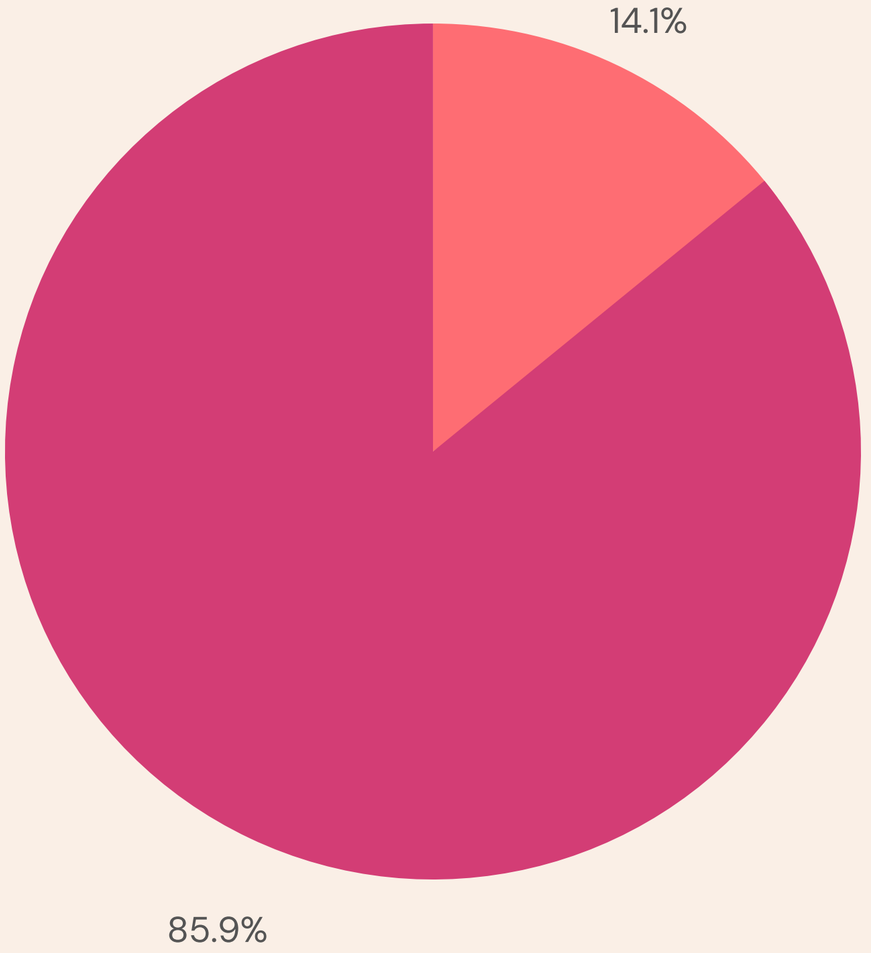
BY TEAM QUANTITATIVE CONQUERORS



UNDERSTANDING THE PROBLEM

14.1%

PROPORTION OF CROPS LOST TO PLANT DISEASES WORLDWIDE



$220 BILLION

IMPACT OF THESE DAMAGES ON THE ECONOMY

Source: Food and Agriculture Organization (FAO)
https://www.fao.org/news/story/en/item/1402920/

PREDICTIVE DISEASE SYSTEM NECESSITY

- Associated Chambers of Commerce and Industry of India reports that annual crop losses due to pests and diseases amount to Rs.50,000 crore.
- Worldwide crop loss due to plant disease is estimated annually to be $220 billion USD or 14.1% of the total production by the Food and Agriculture Organization of the United Nations.
- Managing these diseases is labor-intensive, and market quality may suffer due to blemished fruits. Additionally, climate change exacerbates the issue.
- To address these challenges effectively, an efficient disease prediction system is essential. Such a system would enable early detection, timely interventions, and the implementation of preventive measures, supporting sustainable tomato crop production and enhancing farmers' livelihoods.

TYPES OF DISEASES IN TOMATO PLANT

1. Bacterial Spot: A bacterial disease causing dark, raised lesions on tomato leaves, leading to reduced photosynthesis and yield loss.
2. Early Blight: A fungal disease causing concentric rings with dark borders on lower leaves, potentially defoliating the plant if left untreated.
3. Healthy: Represents disease-free tomato leaves used as a reference for comparison with diseased samples.
4. Late Blight: A highly destructive disease caused by a water mold, resulting in large irregular-shaped lesions with a water-soaked appearance.
5. Leaf Mould: A fungal disease leading to pale yellow lesions on the upper surface of tomato leaves, reducing photosynthesis.

TYPES OF DISEASES IN TOMATO PLANT

Mosaic Virus

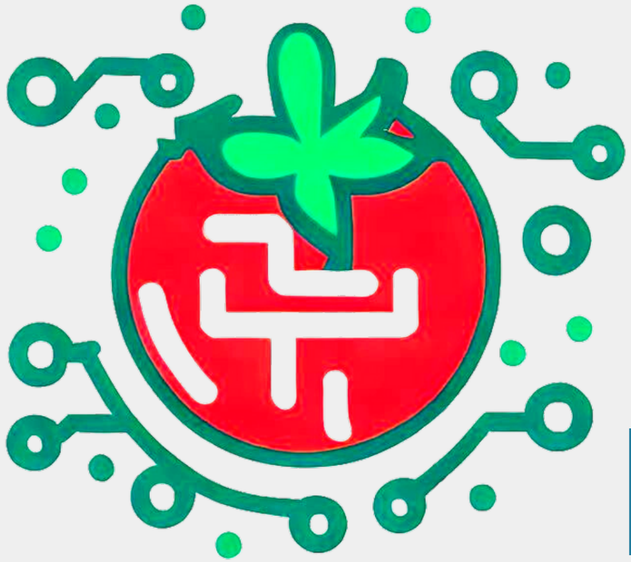
Septoria Leaf Spot

Two Spotted Spider Mites

Target Spot

Yellow Leaf Curl Virus

6. Tomato Mosaic Virus: A viral disease causing mosaic-like patterns on leaves, stunting growth and reducing fruit quality.
7. Septoria Leaf Spot: Characterized by small, circular lesions with dark borders and light centres, often leading to premature defoliation.
8. Two-Spotted Spider Mites: Not a disease but a common pest, these mites cause stippling and webbing on leaves, affecting plant health.
9. Target Spot: Causing circular, dark lesions with concentric rings resembling a target, affecting the lower leaves of the plant.
10. Yellow Leaf Curl Virus: A virus causing yellowing and upward curling of leaves, often resulting in severe yield losses.



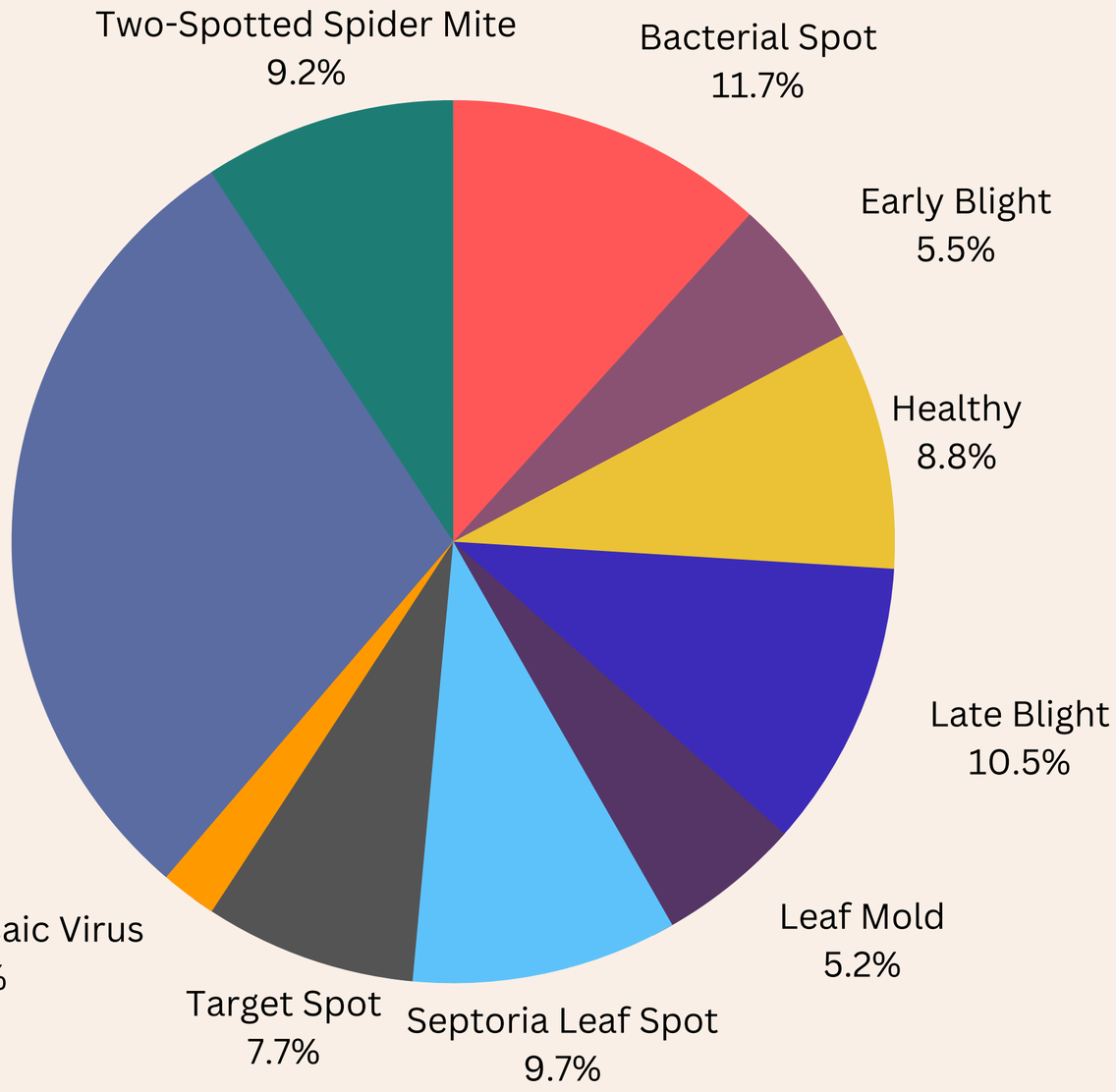
EXPLORATORY DATA ANALYSIS (EDA)

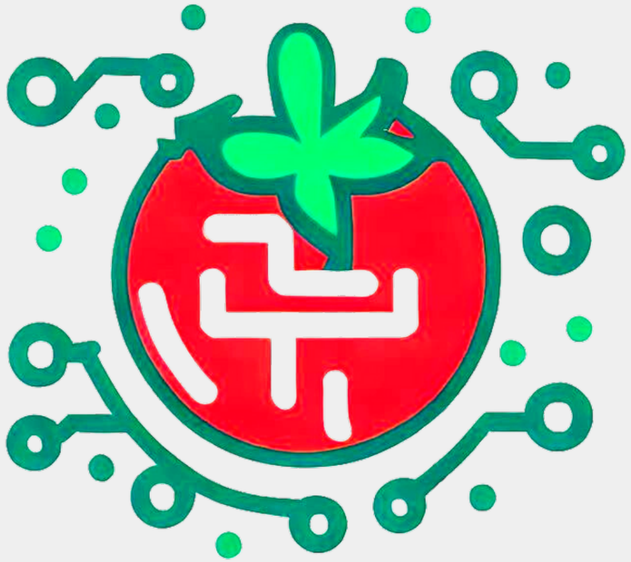
DATA COLLECTION PROCESS

- The dataset we are using is sourced from the PlantVillage database.
- It consists of 14,531 images with ten categories, including nine disease types and one healthy category.
- The images were resized to 227 * 227 during model training.
- This comprehensive dataset enables the model to accurately detect and classify various tomato leaf diseases, promising significant contributions to crop disease management and improved agricultural productivity.

CATEGORY DISTRIBUTION VISUALIZATIONS

(the imbalance present in some classes has been fixed during preprocessing)





BUILDING A SOLUTION

OBJECTIVE OF OUR PROJECT

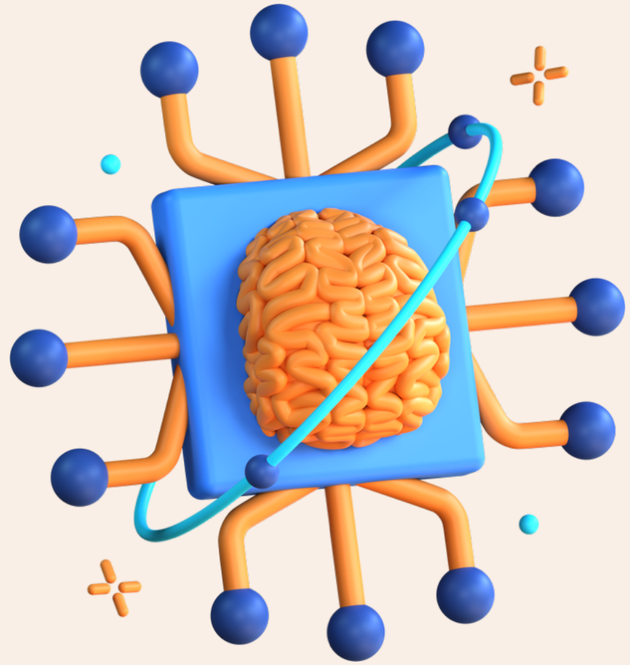
- We aim to help farmers detect plant diseases at an early stage.
- Timely detection will allow for corrective measures such as targeted treatments or adjustments to farming practices, which can prevent the further spread of diseases and minimise crop losses.
- This will help boost crop yields and positively impact both the farmer's income and the nation's food security.

MODEL USED

- We are using a Convolutional Neural Network (CNN) model for this system.

- CNNs are deep learning models specifically designed for processing and analyzing visual data, such as images and videos. CNNs are widely used in computer vision tasks, including image classification, object detection, image segmentation, and more.

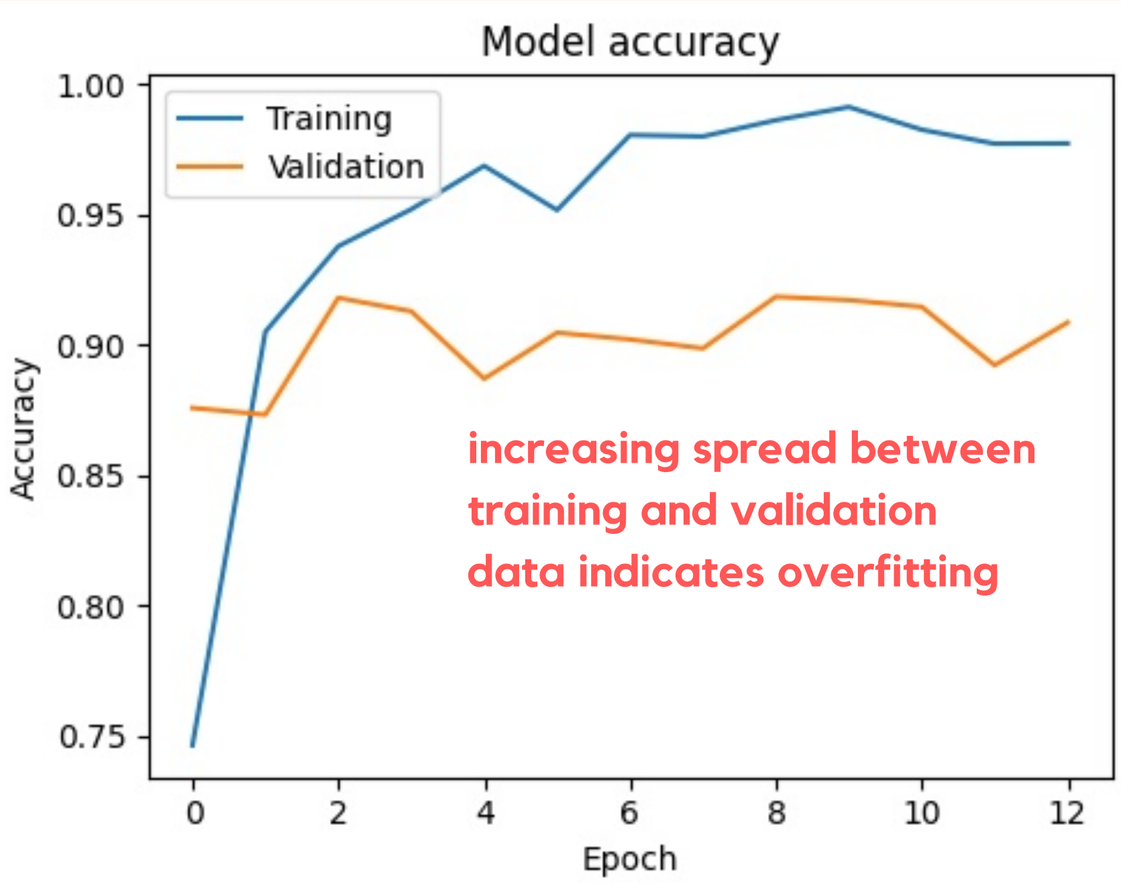
- Due to their effectiveness in handling visual data, CNNs have become the backbone of many computer vision applications and have achieved state-of-the-art results in various similar tasks.

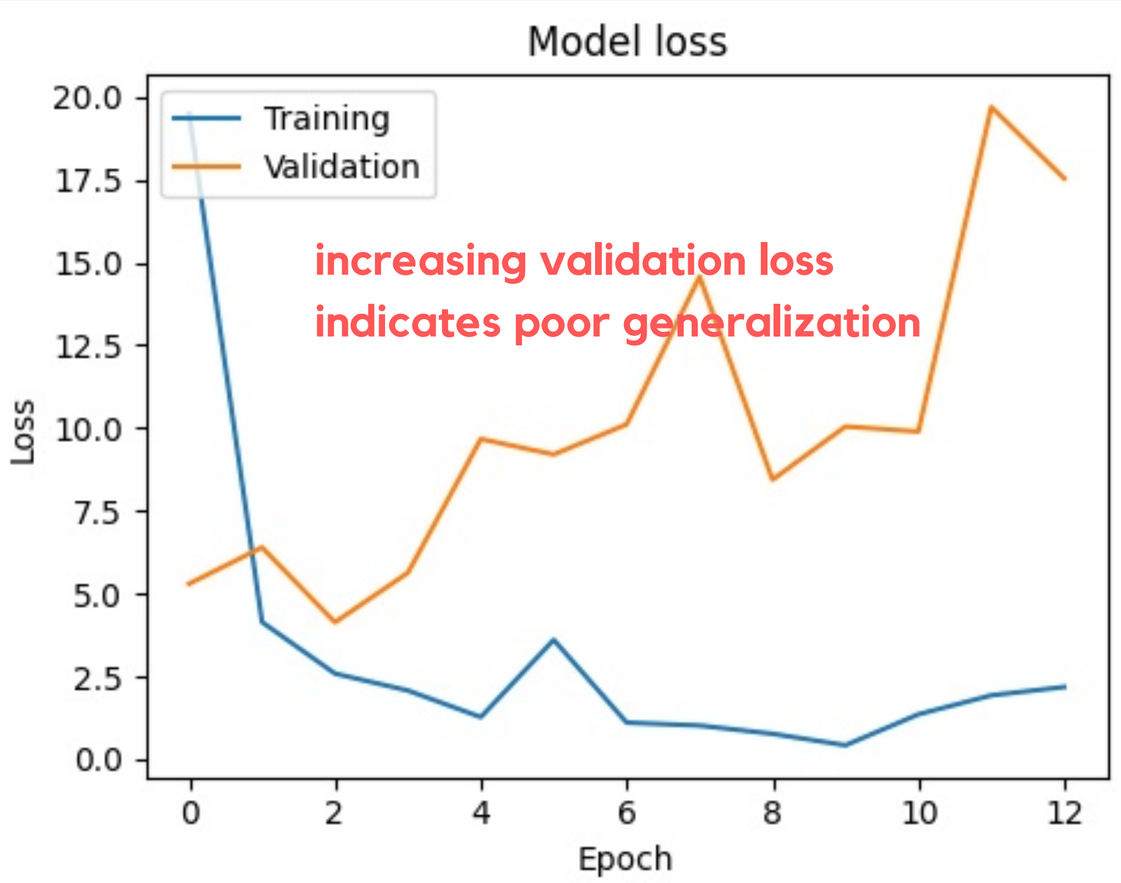


DEVELOPMENT PROCESS

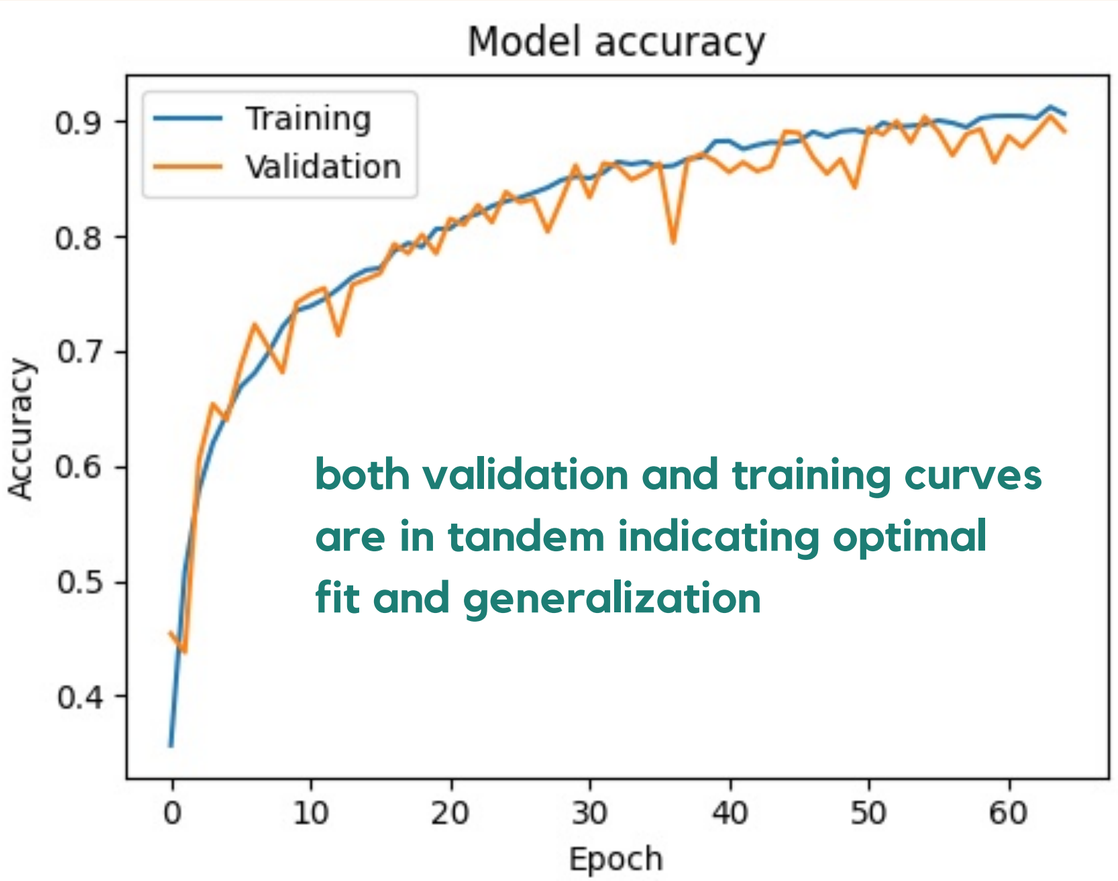
Step 1	**Data Preprocessing**	Resizing images to 227x227, normalizing RGB values, removing transparency.
Step 2	**Split Creation**	Dataset is split into 3 parts for testing (20%), training (64%) and validation (16%).
Step 3	**Training**	Techniques like early stopping are used to handle overfitting and determine optimal number of epochs.
Step 4	**Evaluation**	Model performance is evaluated using metrics like accuracy and error on validation subset plotted over number of epochs.
Step 5	**Testing**	The model is tested on a separate dataset to assess its accuracy and real-world capability.

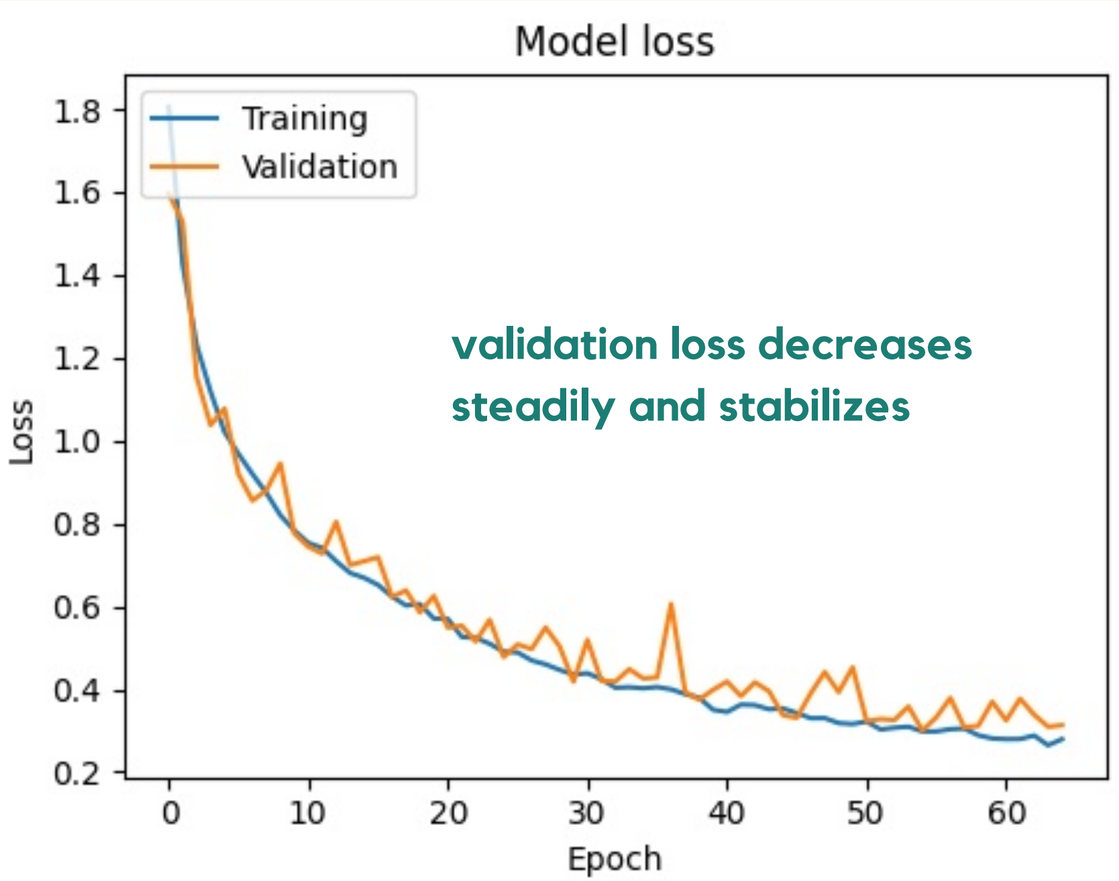
PERFORMANCE EVALUATION METRICS
ATTEMPT #1 - EXAMPLE OF A BAD MODEL





PERFORMANCE EVALUATION METRICS
FINAL ATTEMPT - OPTIMAL MODEL





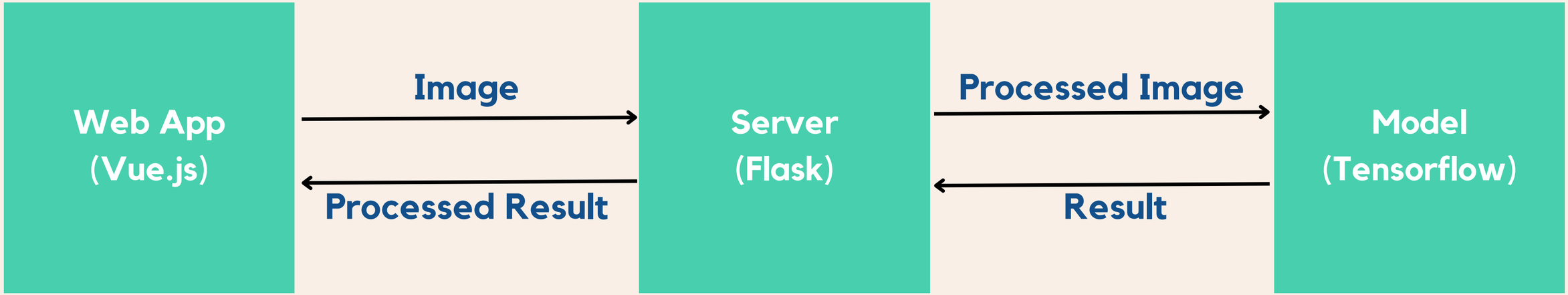
END PRODUCT

LIVE DEMO

Web App (Vue.js): 🔗
https://mlpranav.github.io/tomatoleaf/frontend/

API (Flask): 🔗
https://tomato.sarthakgoelart.repl.co/

ARCHITECTURE AT A GLANCE

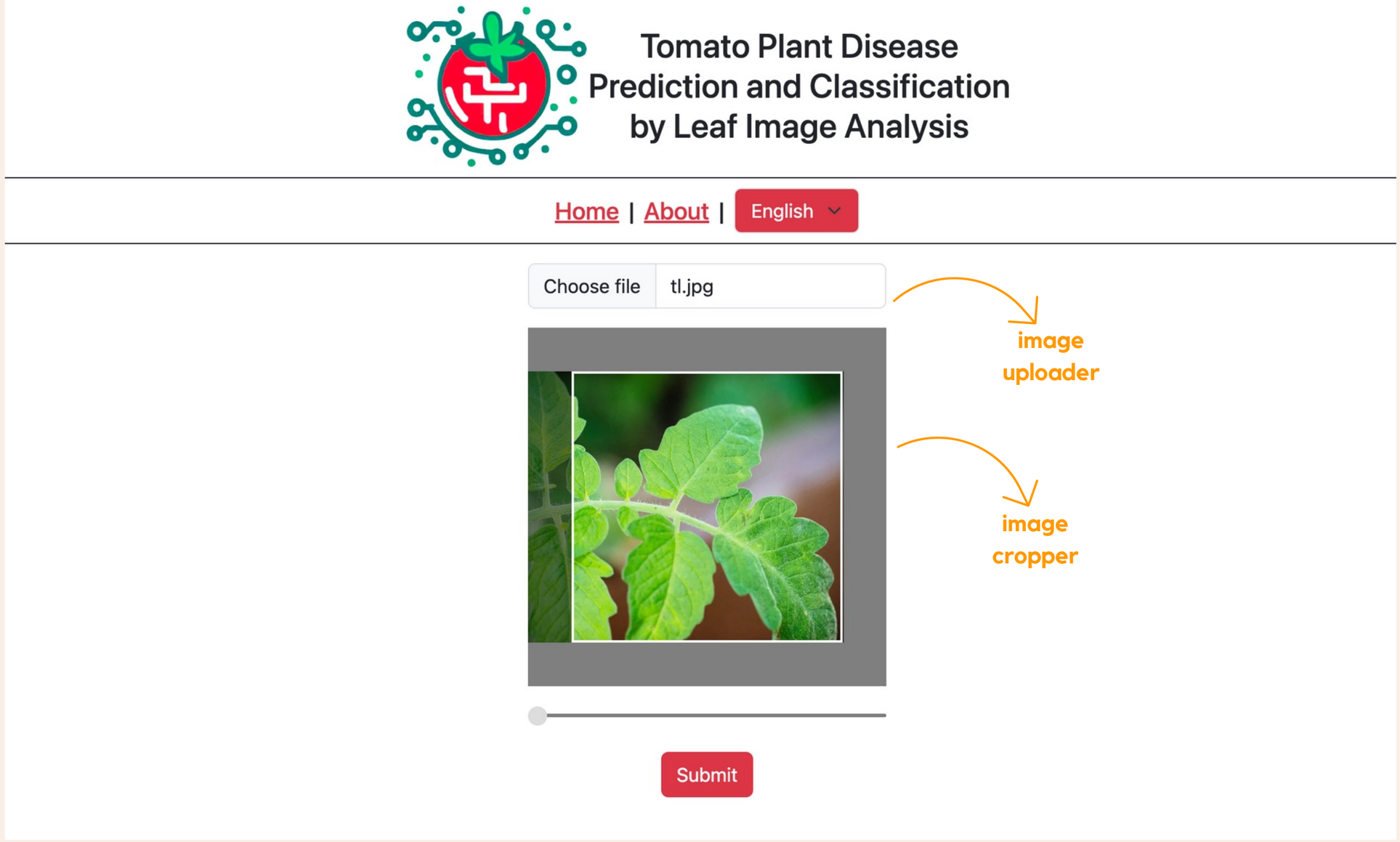


FEATURES

- Allows farmers and gardeners to quickly upload pictures of tomato plant leaves and get a diagnosis of any possible diseases.
- Connected to a Python Flask backend server that uses our trained model to detect the presence of diseases in the supplied images and classify them.
- Supports regional languages like Hindi, Tamil and Bengali to enable maximum reach.
- Displays valuable information like visual cues, prevention, cure, future steps etc so that the detected diseases can be resolved.
- Uses Vue.js for seamless integration and a responsive layout.
- Available on all platforms and devices.

SCREENSHOTS

HOME PAGE



SCREENSHOTS
RESULT PAGE

Chrome File Edit View History Bookmarks Profiles Tab Window Help 61°C 100% Thu 11:40 PM

Tomato Plant Disease Prediction and Classification by Leaf Image Analysis

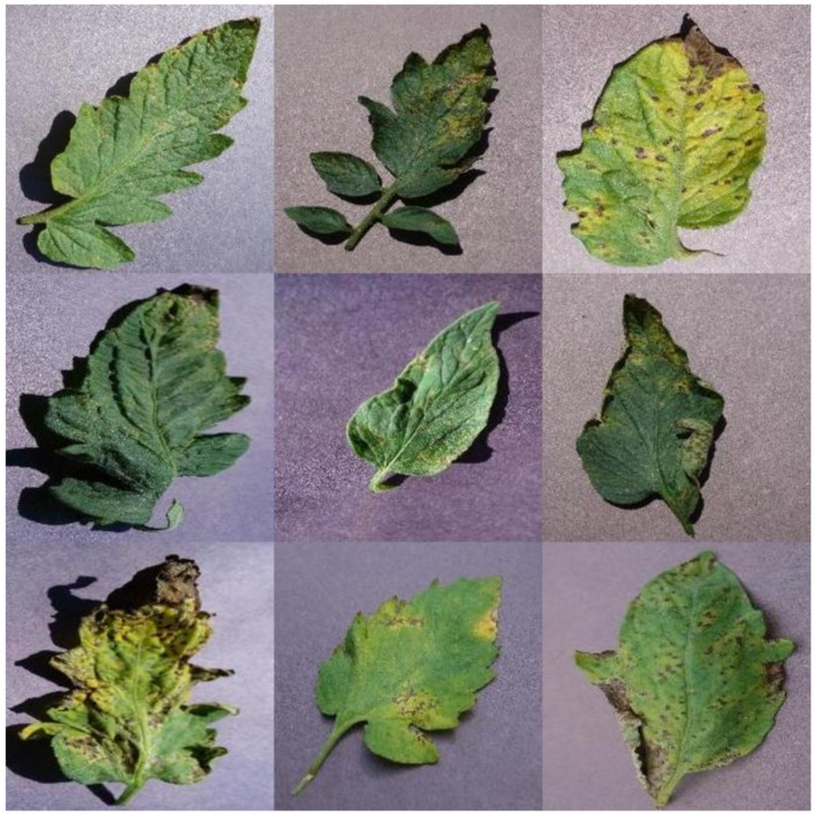
regional language support

Home | About | English

Septoria Leaf Spot

88.34% Match

donut chart of probability



collage for visual confirmation

info about disease

Septoria leaf spot is a fungal disease caused by Septoria lycopersici. It affects tomato leaves and can lead to defoliation.

Visual Cues: Small, dark spots with a tan center and yellow halo on leaves. Spots may coalesce and lead to leaf yellowing and wilting.

Prevention: Remove infected leaves, provide good air circulation, and practice crop rotation.

Next Steps: Control septoria leaf spot with copper-based fungicides. Remove and destroy infected leaves to reduce spread.

Warning: This diagnosis is generated using a machine learning model and is only for reference. Kindly use the visual cues and image given on this page to confirm this diagnosis and also consult an agricultural expert if possible.

SCREENSHOTS
RESULT PAGE

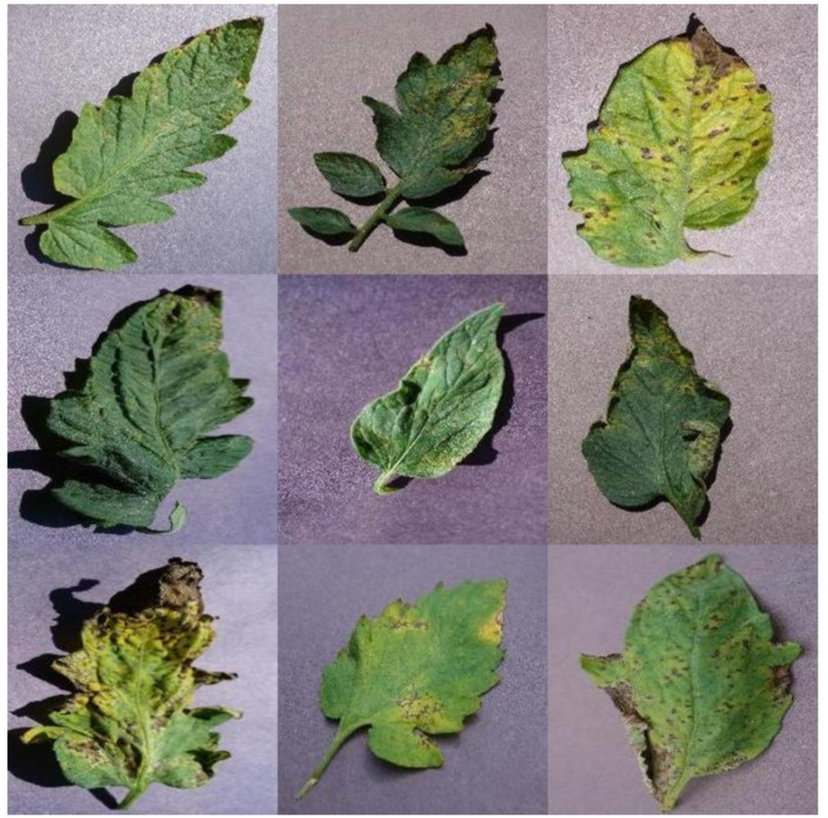
Chrome File Edit View History Bookmarks Profiles Tab Window Help 62°C 100% Thu 11:40 PM

Tomato Plant Disease Prediction and Classification by Leaf Image Analysis

Home | About | हिंदी

Septoria Leaf Spot

88.34% Match



सेप्टोरिया लीफ स्पॉट एक कवक रोग है जो सेप्टोरिया लाइकोपर्सिसि के कारण होता है। यह टमाटर की पत्तियों को प्रभावित करता है और पत्तियां झड़ने का कारण बन सकता है।

दृश्य संकेत: भूरे रंग के केंद्र और पत्तियों पर पीले आभामंडल वाले छोटे, काले धब्बे। धब्बे आपस में मिल सकते हैं और पत्तियां पीली पड़कर मुरझा सकती हैं।

निवारण: संक्रमित पत्तियों को हटा दें, अच्छा वायु संचार प्रदान करें और फसल चक्र अपनाएँ।

अगले चरण: कॉपर-आधारित फफूंदनाशकों से सेप्टोरिया लीफ स्पॉट को नियंत्रित करें। प्रसार को कम करने के लिए संक्रमित पत्तियों को हटा दें और नष्ट कर दें।

चेतावनी: यह निदान एक मशीन लर्निंग मॉडल का उपयोग करके उत्पन्न किया गया है और केवल संदर्भ हेतु है। कृपया इस निदान की पुष्टि करने के लिए इस पृष्ठ पर दिए गए दृश्य संकेत और छवि का उपयोग करें और संभव हो सके तो कृषि विशेषज्ञ से परामर्श करें।

SCREENSHOTS
RESULT PAGE

Chrome File Edit View History Bookmarks Profiles Tab Window Help 61°C 100% Thu 11:40 PM

Tomato Plant Disease Prediction and Classification by Leaf Image Analysis

English
हिंदी
✓ বাংলা
தமிழ்

Home | About |

Septoria Leaf Spot

88.34% Match

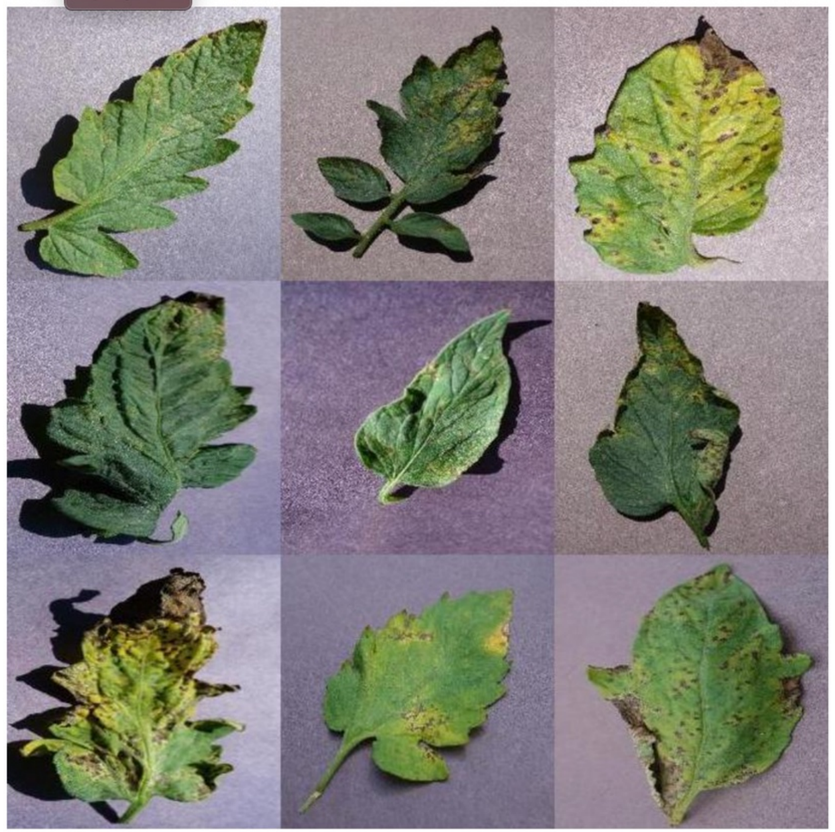
সেপ্টোরিয়া লিফ স্পট হল সেপ্টোরিয়া লাইকোপারসিসি দ্বারা সৃষ্ট একটি ছত্রাকজনিত রোগ। এটি টমেটো পাতাকে প্রভাবিত করে এবং ক্ষয় হতে পারে।

দৃশ্য সূচনা: ছোট, গাঢ় দাগ এবং পাতায় হলুদ রঙের ছত্রাকের কেন্দ্রবিন্দু। দাগ একত্রিত হতে পারে এবং পাতার হলুদ এবং শুকিয়ে যেতে পারে।

প্রতিরোধ: সংক্রমিত পাতা অপসারণ করুন, ভাল বায়ু সঞ্চালন প্রদান করুন এবং ফসল ঘোরানোর অনুশীলন করুন।

পরবর্তী পদক্ষেপ: কপার-ভিত্তিক ছত্রাকনাশক দিয়ে সেপ্টোরিয়া পাতার দাগ নিয়ন্ত্রণ করুন। বিস্তার কমাতে সংক্রমিত পাতা অপসারণ ও ধ্বংস করুন।

সতর্কবাণী: এই নির্ণয়টি একটি মেশিন লার্নিং মডেল ব্যবহার করে তৈরি করা হয়েছে এবং এটি কেবল সন্দর্ভের জন্য। এই নির্ণয়টি নিশ্চিত করতে দয়া করে এই পৃষ্ঠায় প্রদত্ত দৃশ্য সূচনা এবং চিত্রটি ব্যবহার করুন এবং সম্ভব হলে একটি কৃষি বিশেষজ্ঞের সাথে পরামর্শ করুন।



SCREENSHOTS
RESULT PAGE

Chrome File Edit View History Bookmarks Profiles Tab Window Help 64°C 100% Thu 11:40 PM

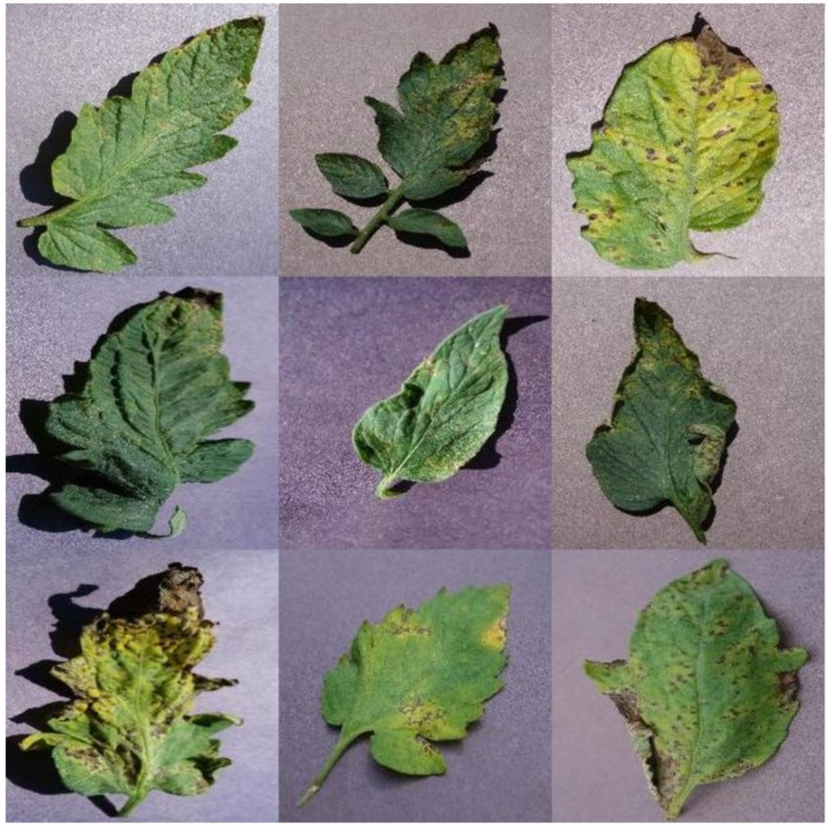
Tomato Plant Disease Prediction and Classification by Lea Analysis

English
हिंदी
বাংলা
✓ தமிழ்

Home | About |

Septoria Leaf Spot

88.34% Match



செப்டோரியா இலைப்புள்ளி என்பது செப்டோரியா லைகோபெர்சிசியால் ஏற்படும் ஒரு பூஞ்சை நோயாகும். இது தக்காளி இலைகளை பாதிக்கிறது மற்றும் இலையுதிர்த்திற்கு வழிவகுக்கும்.

காட்சி குறிக்கோள்கள்: இலைகளில் பழுப்பு நிற மையமும் மஞ்சள் ஒளிவட்டமும் கொண்ட சிறிய, கருமையான புள்ளிகள். புள்ளிகள் ஒன்றிணைந்து இலை மஞ்சள் மற்றும் வாடுவதற்கு வழிவகுக்கும்.

தடுப்பு: பாதிக்கப்பட்ட இலைகளை அகற்றவும், நல்ல காற்று சுழற்சியை வழங்கவும், பயிர் சுழற்சியை பயிற்சி செய்யவும்.

அடுத்த அதிகாரங்கள்: செப்டோரியா இலைப்புள்ளியை தாமிரம் சார்ந்த பூஞ்சைக் கொல்லிகளைக் கொண்டு கட்டுப்படுத்தவும். பரவுவதைக் குறைக்க பாதிக்கப்பட்ட இலைகளை அகற்றி அழிக்கவும்.

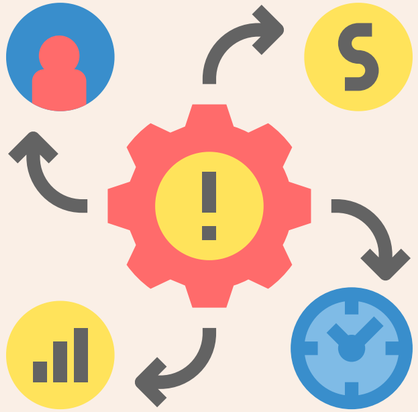
எச்சரிக்கை: இந்த ஆலோசனை ஒரு இயந்திரப் பயிற்சி மாதிரியைப் பயன்படுத்தி உருவாக்கப்பட்டது மற்றும் இது கேவலம் குறிப்புக்கு மட்டுமே. இந்த ஆலோசனையை உறுதிப்படுத்துவதற்கு, இந்த பக்கத்தில் உள்ள காட்சி குறிக்கோள்கள் மற்றும்

THE FUTURE

IMPACT

1. Early Disease Detection: This system can detect the onset of tomato leaf diseases at an early stage. Early detection allows farmers to take proactive measures to contain the spread of the disease and minimize its impact on the crop.

2. Increased Crop Yield: With timely disease detection and appropriate interventions, the tool can help prevent or reduce the severity of diseases. This, in turn, can lead to higher crop yields and better-quality tomatoes.



3. Cost Savings: By minimizing the use of chemical treatments and optimizing the application of fungicides or pesticides, the prediction tool can result in cost savings for farmers. They can target specific areas affected by the disease instead of treating the entire crop.

4. Farmer Education: The tool can also serve as an educational resource for farmers, helping them understand various diseases, their causes, and how to identify and manage them effectively.

5. Increased Tomato Quality: By preventing or reducing disease incidence, the prediction tool can lead to improved tomato quality, making them more marketable and desirable to consumers.

SCALABILITY AND POTENTIAL ENHANCEMENTS

- **Support for Various Crops:** Our underlying technology and methodology can be extended to other crops as well. By collecting and annotating datasets for different crops, the model can be adapted to predict diseases in a wide range of agricultural plants, expanding its applicability.

- **Accessibility Features:** Adding features like narration and voice commands will significantly expand the reach of our system to farmers who cannot read or write.

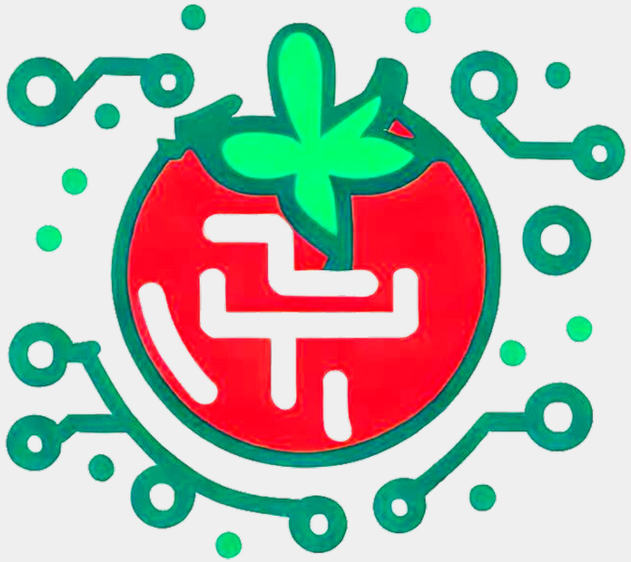
- **Offline Mobile Application:** A user-friendly mobile app would allow farmers to quickly and conveniently assess their crop health using their smartphones or tablets. We will also integrate a lightweight model for on-device prediction in the absence of cellular reception.

- **Real-Time Disease Monitoring:** Integrating IoT devices and sensor networks in the field can enable real-time disease monitoring. IoT-enabled devices can continuously collect data on environmental conditions and crop health, providing farmers with immediate alerts if disease outbreaks occur.

- **Geo-Tagged Data Collection:** Collecting geo-tagged data along with crop images can enable spatial analysis. This can help identify disease hotspots in specific regions and facilitate targeted disease management strategies for different geographic locations.

OUR VISION FOR THE FUTURE OF CROP DISEASE MANAGEMENT

1. Early Detection and Prevention : AI-powered models for diverse crops, enabling early disease detection and prompt action.
2. Customized Solutions : Tailored recommendations based on real-time data and regional conditions.
3. Accessibility for All : Widely available offline applications, reaching farmers in remote areas.
4. Continuous Learning : Regular updates from crowdsourced data and research, improving model accuracy.
5. Sustainable Practices : Promoting eco-friendly approaches, reducing reliance on chemicals.
6. Global Collaboration : Joint efforts of agricultural communities and technology companies.
7. Empowering Farmers : Equipping farmers with knowledge for informed decision-making and improved livelihoods.



THANK YOU!