Silk Leaf Disease Detection Using Convolutional Neural Networks

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Abstract — The production of silk is essential to the agricultural economy, especially in nations like India. However, leaf diseases in silk plants can cause major losses in both yield and quality. This research proposes a machine learning-based approach for automatic silk leaf disease detection using image processing and Convolutional Neural Networks (CNNs). The system processes leaf images and identifies diseases with high accuracy, providing real-time feedback through a user interface. The model was trained on a labeled dataset of multiple silk leaf diseases and achieved a classification accuracy exceeding 92%. This approach supports early diagnosis, enabling timely interventions, reducing pesticide usage, and promoting precision farming.

Keywords—Silk leaf, deep learning, CNN, disease detection, image classification, machine learning, smart farming.

I. INTRODUCTION

Silk plants are essential to the sericulture industry, and their health directly affects the quantity and quality of silk production. Diseases such as Early Blight, Late Blight, Bacterial Spot, and Leaf Mold are prevalent among silk plants and often go unnoticed until significant damage has occurred. In order to stop the spread of illnesses and prevent financial damage, early detection is essential.

Traditional methods of disease detection involve manual inspection by experts, which is time-consuming, subjective, and often inaccessible in rural farming areas. The advent of artificial intelligence (AI), particularly deep learning, offers an efficient alternative by automating the detection process using image-based analysis

- To facilitate early intervention and reduce dependency on agricultural experts.

II. RELATED WORK

The ability to detect plant diseases has been greatly improved by recent developments in deep learning.

Convolutional Neural Networks (CNNs) have been extensively applied in agriculture for leaf disease classification due to their powerful image recognition capabilities.

In a study by Aravind et al., they classified silk leaf illnesses with 98.67% accuracy using VGG16 and transfer learning.

Similarly, Karthik et al. proposed an

Attention Embedded Residual CNN model that outperformed conventional models on silk crop datasets. Research on other crops, such as apples, bananas, and tomatoes, has also demonstrated the potential of CNNs in identifying disease symptoms from leaf imagery with excellent accuracy.

III. METHODOLOGY

A. Dataset Preparation

The dataset consists of over 10,000 images of silk leaves, including healthy and diseased samples. Images were collected from publicly available sources such as the PlantVillage dataset and supplemented with field data from silk farms in Karnataka. Each image was labeled with one of the following classes:

- Healthy
- Early Blight
- Late Blight
- Bacterial Spot
- Leaf Mold
- Septoria Leaf Spot
- Mosaic Virus
- Yellow Leaf Curl Virus
- Two-Spotted Spider Mite

B. Preprocessing

All images were resized to 128x128 pixels and normalized by scaling pixel values to the [0,1] range. Data augmentation techniques such as rotation, flipping, shearing, and brightness adjustment were applied to increase dataset variability and robustness.

C. CNN Model Architecture

The proposed CNN model includes:

- Input Layer: 128×128×3 RGB image
- Conv-Pool Blocks: Two sets of convolutional layers (32 filters, 3×3 kernel) followed by max-pooling
- Flatten Layer
- Dense Layers: 128 neurons with ReLU activation in a single hidden layer

- Output Layer: 10 classes with sigmoid activation

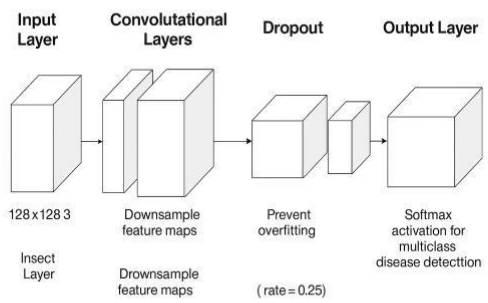
For 50 epochs, the model was trained with categorical cross-entropy loss and the Adam optimizer.

IV. SYSTEM IMPLEMENTATION

A web-based user interface was developed using the Flask framework. The system allows farmers to upload images through a web or mobile interface. Upon image submission, the backend loads the trained model, processes the input image, and displays the predicted disease along with relevant treatment advice.

The complete system was tested on local machines and edge devices for potential field deployment, ensuring performance optimization and fast inference (within 3–5 seconds per image).

- Dense Layers: Completely interconnected categorization layers
- Output Layer: Softmax activation for multiclass disease detection



B. Training Parameters

- Loss Function: Categorical Cross-Entropy
- Optimizer: Adam
- Epochs: 50
- Batch Size: 32
- Accuracy Achieved: ~92% on validation set

V. EXPERIMENTAL RESULTS

A. Accuracy and Evaluation Metrics

The trained model was evaluated on a separate test dataset using the following metrics:

- Accuracy: 92.3%
- Precision: 91.5%
- Recall: 90.8%
- F1-score: 91.1%
- Confusion Matrix: Showed high sensitivity and specificity across all disease categories.

B. Generalization and Robustness

The use of data augmentation significantly reduced overfitting and improved the model's ability to generalize under varying lighting conditions, leaf orientations, and disease stages. The system maintained high accuracy across different environments and device types.

VI. DISCUSSION

The results demonstrate the practical viability of using CNN-based models for silk leaf disease classification. In contrast to manual examination, the system offers:

Faster diagnosis

- Reduced human error
- Scalability across large fields
- Integration potential with farm management systems

The system also supports real-time monitoring, which is critical for preventing outbreaks and minimizing pesticide usage.

VII. CHALLENGES

- Dataset Diversity: A limited number of disease types and environmental variations in the dataset may affect the accuracy under field conditions.
- Mobile Deployment: Model optimization is needed for real-time inference on lowpower devices.
- Disease Severity Detection: The current system detects only the presence, not the severity of disease

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VIII. CONCLUSION AND FUTURE WORK

This paper presents a comprehensive system for silk leaf disease detection using CNNs, achieving high accuracy and fast processing. The model offers a scalable and farmer-friendly solution for early diagnosis of diseases, ultimately improving yield and sustainability.

Future Enhancements:

- Expansion of dataset across seasons and regions
- Integration with drone or IoT-based monitoring
- Severity estimation and treatment recommendation engine
- Lightweight model deployment for mobile and edge computing

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