IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

Smart Plant Disease Detection Using Deep Learning

Nisha Amar Bhosale[1] and Dr. Kiran Tikar[2]
[1]Student, Master of Computer Application
[2]Assistant Professor, Master of Computer Application
Sadhu Vaswani Institute of Management Studies for Girls, Pune
Savitribai Phule Pune University, Pune, Maharashtra, India.

Abstract: *Plant diseases can damage crops and reduce both the quality and quantity of agricultural production. Finding a disease early is important because farmers can take action before it spreads. However, checking plant leaves by looking at them manually is not always easy, especially when different diseases have similar symptoms.*

This research presents a Smart Plant Disease Detection system that uses deep learning and image classification. The system is designed to identify tomato leaf conditions from images and classify them into three categories: Healthy, Early Blight, and Late Blight. A Convolutional Neural Network (CNN) was trained using a plant disease image dataset. The images were prepared and used to teach the model the visual patterns of different leaf conditions.

The trained model was tested with a new image and successfully identified the condition of the leaf. In the project test, a healthy tomato leaf was predicted with 99.99% confidence. A simple Gradio interface was also created, allowing a user to upload a leaf image and get a prediction. The system can make plant disease identification quicker and easier and may help farmers and other agriculture-related users take early action..

Keywords: Smart Plant Disease Detection, Deep Learning, Convolutional Neural Network, CNN, Tomato Leaf Disease, Image Classification, Early Blight, Late Blight, Healthy Leaf, Gradio..

I. INTRODUCTION

Agriculture is important for providing food and supporting the economy. Plant diseases are one of the major problems that can affect agricultural production. If a disease is not detected at the right time, it can spread to other plants and cause crop loss. For this reason, early detection is important for keeping crops healthy.

Traditionally, plant diseases are identified by observing leaves and comparing their visible symptoms. This method depends on a person's experience and can take time. It can also be difficult when many plants need to be checked. Different diseases may have similar symptoms, which can make manual identification less reliable.

Recent developments in Artificial Intelligence and Deep Learning provide a useful way to address this problem. Image-based models can learn patterns such as leaf colour, spots, texture, and damaged areas from training images. A Convolutional Neural Network is especially useful for image classification because it can learn important visual features automatically.

This research focuses on developing a Smart Plant Disease Detection system for tomato leaves. The system uses a CNN model to classify leaf images as Healthy, Early Blight, or Late Blight. The main aim is to provide a simple system in which a user can upload a leaf image and receive a predicted category.

Copyright to IJARSCT
www.ijarsct.co.in
DOI: 10.48175/IJARSCT-38827

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

II. LITERATURE REVIEW

Machine learning and deep learning are being used more often in agriculture to identify plant diseases from images. Earlier methods usually depended on manually selected features such as colour, shape, and texture. These features were then given to a machine learning classifier.

Deep learning has made image classification more effective because the model can learn useful features directly from images. Convolutional Neural Networks are well suited for this type of work because they can learn patterns from different parts of an image.

Plant disease detection studies commonly use datasets containing healthy and diseased leaves. When a model is trained with labelled images, it can learn the visual differences between disease categories. However, the quality and variety of the training images are important. A model trained with limited types of images may not work equally well with images taken in different environments.

In this project, a CNN-based method is used to classify tomato leaf images. Instead of manually checking every image, the model learns from the available dataset and predicts the category of a new leaf image.

III. RESEARCH GAP

Many plant disease detection systems focus mainly on improving classification accuracy. However, a practical system also needs to be easy to use. A model may be technically accurate, but it may not be useful to a farmer or student if it requires complex commands or programming knowledge.

Another challenge is that plant images can be affected by lighting, background, camera quality, and the position of the leaf. Because of this, a useful detection system should have a simple prediction process while also considering the conditions under which the model was trained.

This research addresses this practical gap by combining a CNN image classification model with a simple Gradio interface. The user can upload a leaf image without directly working with the model code, and the system returns the predicted category.

IV. METHODOLOGY

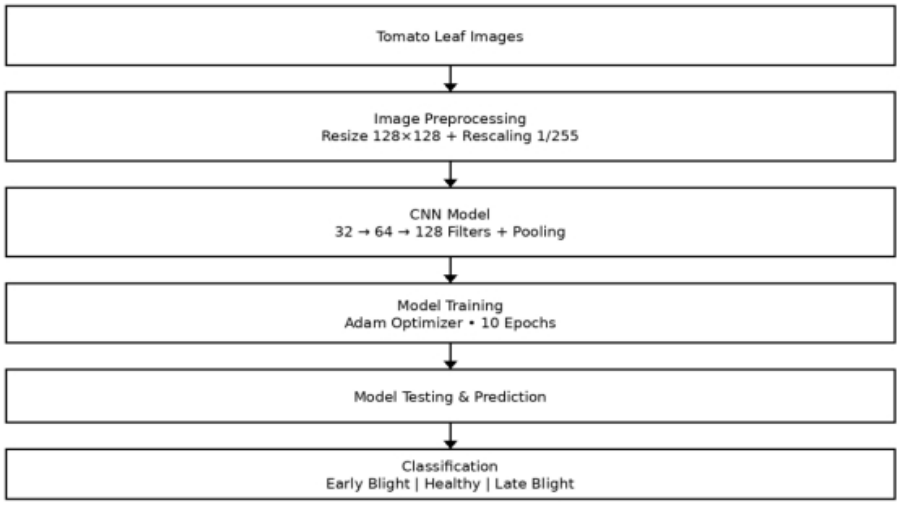


Figure 1. Methodology of the Smart Plant Disease Detection System.

The proposed system follows these main steps: dataset collection, image preparation, model training, model testing, prediction, and interface development.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

Step 1: Dataset Collection

A plant disease image dataset was used to train the model. For this experiment, three leaf conditions were selected: Healthy, Early Blight, and Late Blight.

Step 2: Data Preparation

The images were arranged according to their classes and prepared for training. The image data was given to the CNN so that it could learn the visual characteristics of each category.

Step 3: CNN Model Training

A Convolutional Neural Network was trained to learn patterns from the leaf images. The model was trained for 10 epochs in the project experiment.

Step 4: Model Testing

After training, the model was tested with a new leaf image. The prediction was checked to see whether the model could identify the correct class.

Step 5: Model Export

After successful training, the model was exported and saved. This allows it to be used later for prediction without training it again.

Step 6: Gradio Interface

A simple Gradio upload-and-predict interface was created. It allows the user to upload an image and receive the predicted plant condition through an easy-to-use interface.

5. Dataset

The project uses a plant disease image dataset for training and testing the CNN model. The three selected classes are:

• Healthy – leaves without the target disease symptoms.
• Early Blight – tomato leaves showing symptoms related to early blight.
• Late Blight – tomato leaves showing symptoms related to late blight.

The dataset is arranged in class-based folders so that the model can learn the connection between each image and its category. During the project, the model was trained using the prepared dataset and later tested with a separate image.

A total of 319 images were found during one of the project testing steps. The number and variety of images can affect the performance of a deep learning model. A larger and more diverse dataset could therefore help improve the system in the future.

VI. CONVOLUTIONAL NEURAL NETWORK

A Convolutional Neural Network (CNN) is a deep learning model commonly used for image-related tasks. It can learn visual features from images without requiring every feature to be defined manually.

A CNN generally works through several stages. Convolutional layers find useful patterns such as edges, shapes, and textures. Pooling layers reduce the size of the feature information while keeping important patterns. The later layers use these learned features to classify the image.

In this project, the CNN learns the visual differences between Healthy, Early Blight, and Late Blight tomato leaves. After training, the model takes a new image as input and predicts one of these three categories.

VII. SYSTEM ALGORITHM

1. Start.
2. Load the plant disease image dataset.
3. Arrange the images into Healthy, Early Blight, and Late Blight classes.
4. Prepare the image data for training.
5. Create the CNN model.
6. Train the CNN model for 10 epochs.
7. Save or export the trained model.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

8. Upload a new tomato leaf image.
9. Give the image to the trained model.
10. Predict the leaf category.
11. Display the predicted class and confidence.
12. Stop.

Model Result / Finding

Test Image	Predicted Class	Confidence
Tomato Leaf	Healthy	99.99%

Table 1. CNN prediction result from the project test.

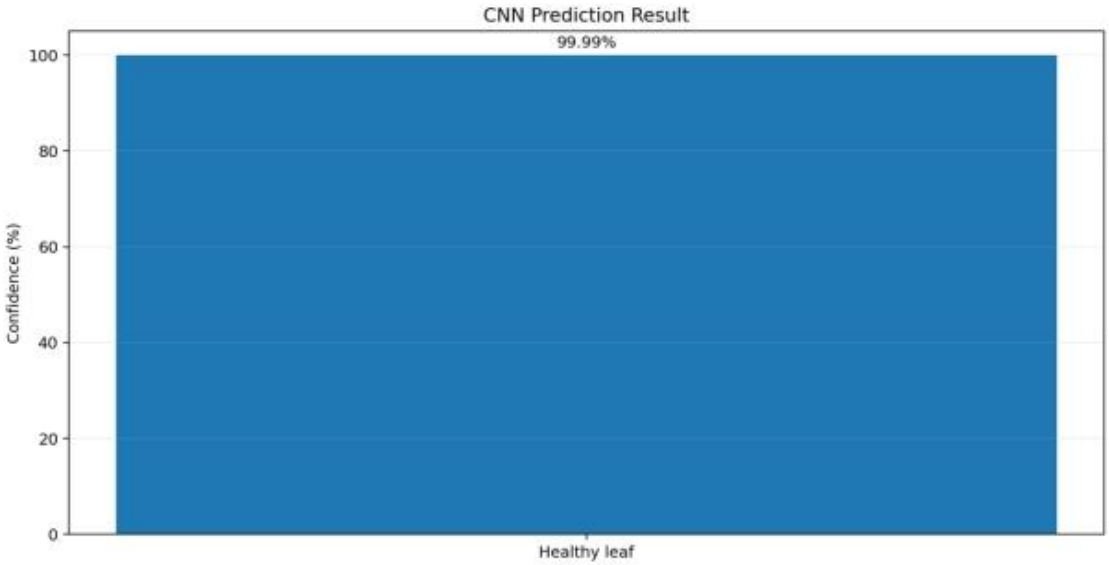


Figure 2. CNN prediction confidence for the tested tomato leaf.

VIII. RESULTS AND FINDINGS

The trained CNN model was successfully used to classify tomato leaf images. During testing, a new tomato leaf image was given to the model. The model predicted the image as Healthy with 99.99% confidence.

This result shows that the model was able to identify the tested image as the selected class. The trained model was also successfully exported for later use. A Gradio interface was connected to the prediction process, allowing the user to upload an image and receive a result through a simple interface.

The main findings of the project are:

- The CNN model can be used to classify tomato leaf images.
- The selected classes are Healthy, Early Blight, and Late Blight.
- The trained model successfully gave a prediction for a new test image.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 2, October 2026
Impact Factor: 8.2

- The tested healthy leaf was predicted with 99.99% confidence.
- The Gradio interface makes the prediction process easier for users.
- The system can be improved by using more images and testing it in a wider range of real-world conditions.

IX. LIMITATIONS

The proposed system has some limitations. First, the model is trained for only three tomato leaf categories, so it cannot identify every possible plant disease. Second, its performance depends on the quality and variety of the training images. Images taken in different lighting conditions, backgrounds, angles, or with different cameras may give different results.

The system provides a classification based only on the categories it learned during training. Therefore, its prediction should be considered an indication and not a final expert diagnosis. In real agricultural situations, doubtful results should be checked by an agriculture expert or another appropriate plant-disease professional.

The project can be improved by increasing the dataset size, adding more disease categories, and testing the model with images collected from real farms.

X. FUTURE SCOPE

The system can be improved in several ways. More plant disease categories can be added so that the model can identify a wider range of diseases. A larger dataset containing images from different farms, lighting conditions, cameras, and plant growth stages could also improve the model's performance on new images.

A future version could be developed as a mobile or web application so that farmers can use the system directly from a phone. It could also provide basic information about the predicted disease and possible next steps, while making it clear that expert advice may still be needed.

Another possible improvement is to compare the CNN model with other deep learning architectures. Their performance could be measured using accuracy, precision, recall, and F1-score. This would give a more detailed comparison of the models.

XI. CONCLUSION

This research presented a Smart Plant Disease Detection system using Deep Learning and a Convolutional Neural Network. The system was developed to classify tomato leaf images into three categories: Healthy, Early Blight, and Late Blight.

The project included dataset preparation, CNN model training, testing, model export, and the development of a simple Gradio interface. The model successfully predicted a new test image as a healthy leaf with 99.99% confidence. This shows that deep learning can be useful for image-based plant disease classification.

The proposed system provides a simple way to detect selected tomato leaf conditions. Although the model has limitations and should not replace expert agricultural diagnosis, it can be used as a supporting tool for early identification. With a larger dataset, more disease categories, and testing with real-world images, the system can be developed further for practical agricultural use.

REFERENCES

1. Hughes, D. P., & Salathé, M. (2015). An open access repository of images on plant health to enable the development of mobile disease diagnostics.
2. Mohanty, S. P., Hughes, D. P., & Salathé, M. (2016). Using Deep Learning for Image-Based Plant Disease Detection.
3. Ferentinos, K. P. (2018). Deep learning models for plant disease detection and diagnosis.
4. The plant disease image dataset used in this project was organized into Healthy, Early Blight, and Late Blight classes for model training and testing.