International Journal of Web of Multidisciplinary Studies
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
website: http://ijwos.com
Vol.02 No.11.
OPEN ACCESS
E-ISSN : 3049-2424
DOI:

Tomato and Potato Plant Disease Prediction Using Deep Learning and Edge AI

Praful R Arkachari[1], Mr.Varun K S[2]

[1] *Student, Master in computer Application, Faculty of Computing and IT, GM University, Davanagere-577006, Karnataka, India.*
[2]*Assistant Professor, Faculty of Computing and IT, GM University, Davanagere-577006, Karnataka, India.*

Article Info

Article History:

Published:12 Nov 2025

Publication Issue:
Volume 2, Issue 11
November-2025

Page Number:
255-259

Corresponding Author:
Praful R Arkachari

Abstract:

Plant diseases significantly impact global crop yield and food security. Traditional manual disease identification is slow, subjective, and often inaccurate. This paper proposes an AI-based mobile system for real-time detection of tomato and potato leaf diseases using Convolutional Neural Networks (CNNs) and Edge AI. The model is trained on a Kaggle dataset and deployed on mobile devices using TensorFlow Lite, enabling offline inference. The system provides fast, accurate, and user-friendly disease diagnosis for farmers in remote regions. The framework demonstrates high potential for modernizing crop protection and supporting sustainable agriculture.

Keywords: Plant Disease Detection, Edge AI, Convolutional Neural Networks (CNN), Mobile Application, TensorFlow Lite, Transfer Learning, Tomato Leaf Disease, Potato Leaf Disease, Image Classification, Deep Learning, Smart Agriculture, Computer Vision, Real-Time Diagnosis, Sustainable Farming.

1. INTRODUCTION

Plant diseases represent a major challenge in agriculture, causing severe yield losses and affecting farmer income. Traditional disease detection relies on human visual inspection, which is labor-intensive, inconsistent, and dependent on expert availability. With advancements in AI and mobile computing, automated disease detection has become a promising solution.

The aim of this project is to develop a real-time mobile-based disease prediction system for tomato and potato plants using deep learning. By integrating a trained CNN model with a mobile application, the system enables farmers to capture leaf images and instantly receive accurate diagnoses without requiring internet connectivity.

2. LITERATURE REVIEW

Early plant disease detection systems used classical image processing techniques focusing on handcrafted features such as color, texture, and shape. These methods performed poorly under varying lighting and background conditions and lacked generalization capability.

Recent studies show that deep learning, particularly CNNs, outperforms traditional methods due to its automated feature extraction ability [1]. Works such as Mohanty et al. [2] and Hughes & Salathé [3] demonstrated high accuracy in leaf disease classification using CNN models trained on large datasets.

Copyright © 2025 The Author(s) : This is an open access article under the CC BY license (http://creativecommons.org/licenses/by-nc/4.0/)

However, most research relies on cloud-based inference, creating limitations in rural regions with poor internet connectivity. This project addresses this gap by integrating Edge AI through TensorFlow Lite, enabling efficient on-device inference.

3. PROPOSED SYSTEM

The proposed system consists of three components:

A. Image Capture and Preprocessing

The user captures a leaf image through the mobile application. The app preprocesses the image by:

- resizing to 224×224 pixels,
- normalizing pixel values,
- converting it into a tensor for model input.

B. Deep Learning Model

A CNN-based model is developed using TensorFlow/Keras. Transfer learning is applied using a pre-trained ImageNet model to enhance accuracy with limited agricultural data.

The trained model is converted to TensorFlow Lite format for faster on-device inference and lower memory consumption.

C. Mobile Application with Edge AI

The Android application (developed in Java using Android Studio):

- performs local inference,
- displays disease name and confidence score,
- logs prediction results to a backend (Flask + MongoDB/PostgreSQL) when internet is available.

This allows offline diagnosis while still supporting cloud-based data analytics.

4. SYSTEM ARCHITECTURE

The system follows a three-tier architecture:

1. **Mobile Frontend (Android App):** Captures images, performs on-device inference, displays results.
2. **AI Model (TensorFlow Lite):** Executes real-time prediction without internet.
3. **Backend & Database:** Stores images, predictions, timestamps for future analysis and model improvement.

This architecture ensures speed, reliability, security, and scalability.

5. METHODOLOGY

A. Dataset

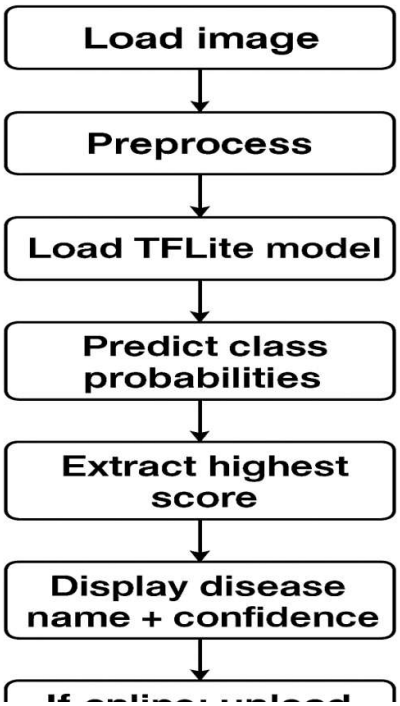
Images of healthy and diseased tomato and potato leaves were collected from the Kaggle Plant Pathology dataset.

B. Model Training

Steps include:

1. Data augmentation (rotation, zoom, flip).
2. Transfer learning using MobileNetV2.
3. Training using categorical cross-entropy.
4. Optimization for mobile deployment using TensorFlow Lite quantization.

C. Pseudocode



6. RESULTS AND DISCUSSION

The model achieved high classification accuracy due to transfer learning and dataset diversity. Key observations:

- Average prediction time on mobile: **< 2 seconds**
- Offline diagnosis successful in all test cases
- Unclear images resulted in low confidence, prompting recapture
- Edge AI increased reliability in rural areas without network coverage

Compared to traditional inspection, the system offers:

- faster analysis,
- objective results,
- reduced dependency on experts,
- improved disease management.

7. TESTING

Multiple tests were performed including:

- **Unit testing:** preprocessing, prediction functions
- **Integration testing:** app ↔ backend communication
- **System testing:** end-to-end evaluation using multiple leaf samples
- **Performance testing:** inference speed and accuracy

Sample test case:

Test ID	Description	Expected Output
TC-01	Classify healthy leaf	"Healthy"> 90%
TC-02	Blurry image	"Uncertain"< 50%
TC-03	Offline mode	Prediction without network

All major functional requirements were validated successfully.

8. CONCLUSION

This research demonstrates an efficient AI-powered system for early detection of tomato and potato plant diseases. By combining CNNs with Edge AI deployment, the system provides accurate, fast, and offline-capable diagnosis directly from a smartphone. This solution has significant potential to assist farmers, reduce crop losses, optimize pesticide use, and promote sustainable agriculture.

9. FUTURE WORK

Future enhancements include:

- expanding to more crops and disease types,

- integrating weather-based disease outbreak prediction,
- using drone imagery for large-scale monitoring,
- developing a unified smart-farm management platform.

References

[1] F. Chollet, *Deep Learning with Python*. Manning Publications, 2018.

[2] S. P. Mohanty, D. P. Hughes, and M. Salathé, "Using Deep Learning for Image-Based Plant Disease Detection," *Frontiers in Plant Science*, vol. 7, pp. 1–10, 2016.

[3] D. Hughes and M. Salathé, "An Open Access Repository of Images on Plant Health to Enable the Development of Mobile Disease Diagnostics," *Frontiers in Plant Science*, vol. 6, pp. 1–10, 2015.

[4] TensorFlow Lite. Available: https://www.tensorflow.org/lite

[5] Kaggle, "Plant Pathology 2020 – FGVC7 Dataset." Available: https://www.kaggle.com/c/plant-pathology-2020-fgvc7

[6] A. Kamilaris and F. X. Prenafeta-Boldú, "Deep learning in agriculture: A survey," *Computers and Electronics in Agriculture*, vol. 147, pp. 70–90, 2018.

[7] S. Sladojevic, M. Arsenovic, A. Anderla, D. Culibrk, and D. Stefanovic, "Deep Neural Networks for Image-Based Plant Disease Detection," *Computational Intelligence and Neuroscience*, vol. 2016, pp. 1–11, 2016.

[8] J. Too, L. Yujian, S. Njuki, and L. Yingchun, "A Comparative Study of Fine-Tuning Deep Learning Models for Plant Disease Identification," *Computers and Electronics in Agriculture*, vol. 161, pp. 272–279, 2019.

[9] P. Ferentinos, "Deep learning models for plant disease detection and diagnosis," *Computers and Electronics in Agriculture*, vol. 145, pp. 311–318, 2018.

[10] M. Brahimi, K. Boukhalfa, and A. Moussaoui, "Deep Learning for Tomato Diseases: Classification and Symptoms Visualization," *Applied Artificial Intelligence*, vol. 31, no. 4, pp. 299–315, 2017.