IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 7, July 2022

DOI: 10.17148/IJIREEICE.2022.10727

# Tomato Plant Disease Identification

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**Abstract**: Plant infections are one of the issues in the agricultural industry. Disease on plant leads to the substantial drop in both the quality and output of agricultural goods. Early identification and detection of plant diseases are therefore crucial. Plant illnesses frequently manifest on the leaves, and the diseased leaves' characteristics might vary and make them difficult to identify. Automatic disease identification is therefore challenging. It is possible to employ image processing techniques. Typically, illness symptoms can be noticed on the leaves. In this work Convolution neural networks and ensemble classifiers are employed in this study to categorise tomato disease into 7 groups (six disease and one healthy class), each with 100 photos. This study has effectively identified tomato plant disease using an automatic leaf image detection method with an accuracy of 96% and 92%.

**Keywords:** Image processing,Convolutional neural network, Ensemble

## I. INTRODUCTION

India is a developed nation where agriculture supports about 80% of the population. Farmers can choose from a wide variety of acceptable crops and find the right pesticides and herbicides for plants. Research on visually discernible patterns on plants are referred to as plant disease studies. Then, to find all potential subgroups, we employ the CNN and Ensemble classifier algorithms. Health of plant tomato leaf and disease on plant tomato leaf plays an important role in successful cultivate of crops in the farm. It is possible to employ image processing techniques. Typically, illness symptoms can be noticed on the leaves. Analyzing and working with the image involves data compression, image augmentation, and identifying patterns that are invisible to the human eye, such as in satellite photos. The output step is the final one when a picture or report based on image analysis might be altered.Even though the world has made great efforts to reduce plant mortality and increase food security, references [1] reveal that plant diseases are to blame for more than 20% of crop losses globally. The effects of pollution and climate change have made this problem more significant in the last ten years.Recent advancements in agricultural technology have led to farmers choosing plant disease databases or calling their local pathologists for advice rather than using the traditional method of sending their plants to a diagnostic lab so they may recommend the best course of action. Additionally, there are numerous initiatives to leverage ICT tools to boost agricultural development efficiency while leveraging the widespread use of mobile phones.

Tomatoes have a lot of nutrients, but they also provide health benefits that can help you avoid conditions like hypertension, hepatitis, gingival bleeding, and more[2]. Because tomatoes are used so often, there is a rising demand for them. Statistics show that small farmers produce more than 80% of all agricultural output, and that more than 50% of productivity losses are attributable to diseases and pests. Research into the detection of crop illnesses is crucial since diseases and insect pests are the key factors impacting tomato development.

Machine learning has been used to detect plant diseases in a number of studies. SIFT, HOG [3], and other manually created features are often used as inputs in traditional machine learning approaches. Applying this method to online applications may be difficult since it necessitates more complex calculations. It's also possible that the results won't be adequate. To extract the traits with more precision, more sophisticated instruments may be required, such as spectroscopy, infrared spectral patterns, and plant phenotyping, which smallholder farmers would not be able to purchase.

## II. LITERATURE REVIEW

A sophisticated Convolution brain network (CNN) was proposed by Surmapalli Ashok et al. [4] for the identification of tomato leaf infection. In a growing horticultural industry, early detection of leaf disease is crucial, which is why this study is being used. A discrete wavelet change (DWT) indicates vertical, even, diagonal, and GLCM in light of these factors. They must be aware of the four varieties of tomato leaf illness. Using a convolutional neural network, the tomato leaf disease recognition produced a high accuracy rate of 98.12 percent.

A sophisticated Convolution brain network (CNN) was suggested by Surmapalli Ashok et al. [5] for the identification of tomato leaf infection. An important necessity in a growing horticulture economy is the early detection of leaf disease, which is the purpose of this study. Due to factors like Discrete Wavelet Change (DWT), which suggests Vertical, Even

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and Diagonal, and GLCM. They must be able to distinguish between the four varieties of tomato leaf disease. Using a convolutional neural network, the tomato leaf disease recognition produced a high accuracy rate of 98.12%.

A tomato leaves disease identification system is carried out in Bangladesh by Tahmina Tashrif Mim et al.[6] using image processing and convolutional neural networks (CNN). With the aid of a picture-handling framework, dangerous signs of synthetic substances and pesticides were examined. This research project distinguishes six different tomato leaf illnesses, including one solid class. This investigation examined and dissected tomato leaves in great detail. The final part of the suggested model has an accuracy of 96.55 percent.

By using a convolutional neural network, M.M. Gunarathna et al. [7] have suggested a system to recognise tomato leaf sickness (CNN). identifying the ideal balance of boundaries in this work. The 22930 tomato leaf images were collected from the Plant Town Kaggle dataset. The model was tested for a particular set of limits while maintaining constant borders. The most notable preparation accuracy, approval accuracy, and anticipation accuracy achieved from the review, respectively, are 92 percent, 94 percent, and 92 percent.

Using AI, P. Maheswari et al.[8] promoted an early scourge illness of tomato leaves. This work identifies healthy leaves and tomato leaf scourge infection early on. The method described in this study uses foldscope and AI computations to identify the Alternaria solani bacteria that causes the early-stage infectious sickness in tomato leaves. Manu Prakash and his team created the Foldscope, a paper magnifying tool. Alternaria Solani's image was captured. Different artificial intelligence (AI) algorithms, including LDA, KNN, direct SVM, and quadratic SVM, were used to group the captured images. When compared to other AI calculations, the quadratic support vector machine (SVM) exhibits the highest grouping precision of 89 percent in the forecast step.

A tomato plant disease identifying test is carried out by Akbar Hidayatuloh et al[9] using a sophisticated convolutional neural network. Early detection of plant diseases is important since they can lead to a drop in agricultural production. Several models using the CNN technique have been created, including. Alexnet,ZFNET,VGG,etc The sequeezenet Architecture, which includes solid leaves, groups seven different tomato plant diseases. The model is created with the aid of the Keras deep learning technologies. With a typical accuracy of identifiable proof of 86.92 percent, these reviews have successfully identified tomato plant illness through its leaf image.

Programmable identification and detection of tomato leaves illness using sophisticated convolutional brain structure was suggested by Azeddine elhassouny et al[10]. The CNN has a vast array of areas that are similar to PC vision, such as order item positioning and division, which achieves preferred exactness over human level discernment. The perception of 10 common tomato leaf diseases. The model's accuracy is 88.4 percent.

Using profound learning, Suryawati et al. [11] have suggested recognising tomato leaf illness. One of the important methods for demonstrating object differentiation in deep learning is CNN. several CNN models, such as the simple CNN Baseline ( with 2 layers of convolutional layers). Alexnet (5 convolutional layers), VGGNet (13 convolutional layers), and GoogleNet architectures are also evaluated. According to the trial results, CNN outperforms competitors by using a more sophisticated design, such as VGGNet, and has greater advantages over them for the task.

Using image processing and IoT sensors, Shradha verma et al.[12] carry out location and expectation models for tomato plant disease. With farming space, AI, and computer vision being the most researched and implemented improvements, irritations and established illnesses have remained a constant threat to the higher quality and quantity of typically crop prediction throughout history. The eight classes of tomato plant diseases (seven diseases and one sound class). Deep learning demonstration techniques, ANN, SVM, and the Extreme Learning Machine (ELM) classifier are used.

Using deep learning, Rubini PE et al[13] promoted the expectation of tomato plants becoming ill. A sophisticated learning model is put forth in this work and shows whether or not a leaf image has an infection and what kind of illness it represents. The tomato plant pictures were created using pretrained models like VGG16 and Dense Net using move learning and precision analysis. They were taken from the plant town dataset. The 95–97% accuracy of the profound learning model was order.

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## III. PROPOSED WORK METHODOLOGY

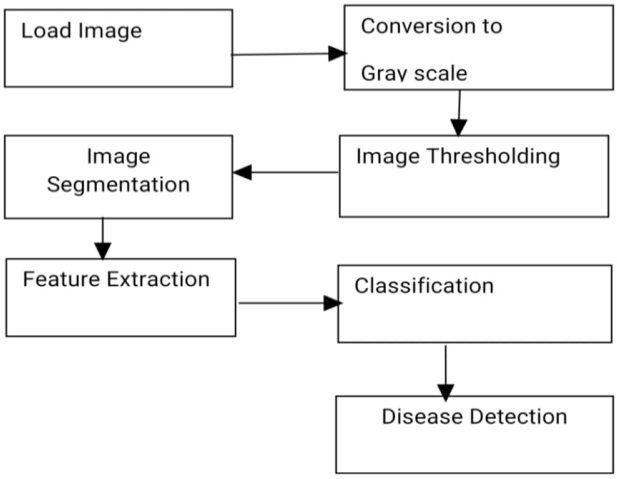


**Fig 1.Block diagram of proposed system**

The project shown in Fig. 1 is carried out in a modular fashion. Each module is developed and tested according to the specifications, and this procedure is repeated until each module is fully functional.
The system will first detect the disease and the user can view the output after the system has detected it. The user will upload a leaf image, which will be quickly converted to grayscale for faster processing. After grayscale, the user will see the results of image segmentation and feature extraction.

**Ensemble classifier**
After performing a segmented analysis of the matrix, the matrix value information will appear as one gradient level, a grouping using logistic regression, and an iterative analysis. Once the iterative analysis is complete, data validation and a data representation model will appear, classifying the classes to which the various categories belong.

**CNN(convolutional neural network)**
The node match value is displayed after the image is first grouped based on a parameter like the number of pixels. We will categorise depending on the node match value. We take a confidence rating of more than 0.5 in that there will always be more than one class in that class before we make a decision.

*A.* Data Acquisition(Dataset Collection)
We have to identify 7 classes(6 disease and 1 healthy class) in that 4 types of diseases are collected from real time(nurseries) such as healthy image,early blight,late blight,southern blight and remaning Three diseases—bacteria image, target spot, and mosaic virus—are gathered from the Kaggle website (https://www.kaggle.com/datasets/kaustubhb999/tomatole af).

| Class labels | samples |
|---|---|
| Tomato blight | 100 |
| Early blight | 100 |
| Late blight | 100 |
| Southern blight | 100 |
| Target spot | 100 |
| Bacterial spot | 100 |
| Mosic virus | 100 |
| Total | 700 |

## IV. EXPERIMENTAL RESULTS AND DISCUSSION

The seven classes—healthy image, early blight, late blight, southern image, bacteria image, target spot, and mosaic virus—must be identified.By extracting the features like greyscale, Binarization,Threshold and comparative study of convolutional neural network and Ensemble classifier.By these parameters we are using like height,width,range,skewness,mean,median,entropy.

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Below fig2 show the identification of healthy image with the accuracy of convolutional neural network(cnn) accuracy is 95.7% and ensemble accuracy is 92%.
Below fig3 show the identification of tomato early blight with the accuracy of convolutional neural network(cnn) accuracy is 95.08% and ensemble accuracy is 92% and remaining disease also identified such as late blight,sothern image,bacteria image,target spot,and mosaic virus.


**Fig 2 .Tomato healthy image identification**

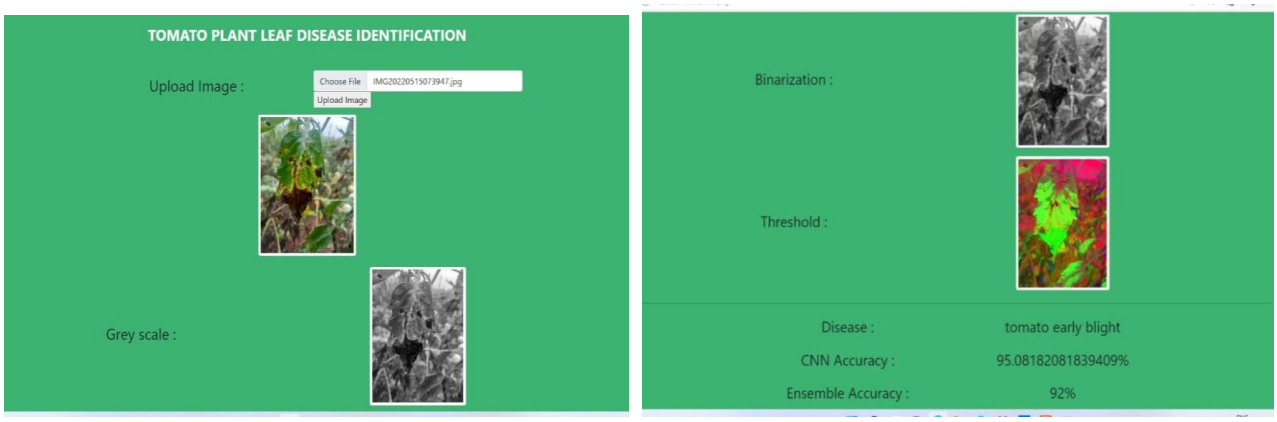


**Fig 3.Tomato early blight identification**

## V. CONCLUSION

The main goal of "Tomato Plant Disease Identification" is to identify tomato plants on any surface using Convolutional Neural Networks (CNN) and Ensemble. The most accurate methods for this kind of image classification, with 96 and 92 percent accuracy, are CNN and Ensemble. The majority of the Indian village's farmers are unaware of this identification. I believe that this effort has the potential to alter India's agricultural growth condition.
In the future, collect more number of real time tomato plant disease images and to identify the disease name and better accuracy.

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