Tomato Leaf Disease Prediction

A synopsis

for

Project work-1

BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE & ENGINEERING

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Introduction

Precision farming is the next step in the evolution of agriculture. Precision agriculture may boost agricultural output by combining science and technology. Precision farming also entails reducing pesticides and illnesses by accurately calculating the number of pesticides needed. Precision farming has improved several agriculture sectors as it transitions from conventional ways to new approaches. Precision farming's only objective is to obtain realtime data to boost agricultural yield and maintain crop quality.

Agriculture is much more than just a means of feeding the world's growing population. Plant diseases have also cost agricultural and forestry businesses a lot of money. As a result, early identification and diagnosis of plant diseases are crucial to take fast action. Plant illness may be detected using a variety of techniques. Certain ailments, on the other hand, are difficult to diagnose early on.

They will have to wait a little longer to figure out what is going on. Advanced analysis, which is often done with powerful microscopes, is necessary under these conditions. Diseases wreak havoc on a plant's overall health, slowing its development. Unfortunately, a plethora of tomato diseases is wreaking havoc on the leaves of the crop.

The proposed study's primary objective is to find a solution to the problem of identifying tomato leaf disease using the most straightforward technique feasible while utilizing the fewest computer resources necessary to achieve results comparable to state-of-the-art alternatives. In addition, to assist in classifying input photos into sickness classifications, automatic feature extraction is applied. Consequently, the suggested system attained an average accuracy of 94%-95%, demonstrating the neural network approach's viability even under challenging scenarios.

Sensors and remote sensing, mapping and surveying, high-precision positioning systems, variable rates, the global navigation satellite system, automated steering systems mapping, computer-based applications, and other technologies are all used in precision agriculture. In addition, precision agricultural concepts based on infrared variation analysis and treatment are also cutting-edge technologies. This examination utilizes a more modest adaptation of the convolutional neural organization model to recognize and analyze messes in tomato leaves.

In other cases, the signals can only be detected in non-visible electromagnetic spectrum areas. This research aims to develop a user-friendly method that will aid farmers in recognizing tomato plant issues without having to consult an expert. We first obtain a picture from the Kaggle dataset, from which we extract characteristics. To extract the attributes, we employ picture conversion and scaling. To diagnose diseases, the transfer learning inception v3 model will be used.

Fig . Tomato Leaf

1.2 Image Processing in Precision Agriculture

Precision agriculture uses deep learning techniques, and its approach to crop protection effectively boosts crop development. Image analysis may be used to detect the sick leaf and measure and locate the damaged area's border to identify the item appropriately. This study develops an improved deep learning system for determining the state of a tomato crop based on a photo of its leaves.

We all know that the human brain recognizes images far faster than a computer. However, the era has changed with the introduction of Machine Learning. High performance on image identification tasks may be ensured using the model, deep convolution neural network, which can surpass human performance in several domains. By certifying their work against Image Net, researchers have achieved advances in the field of visual recognition.

Literature Review

Symptoms of Tomato Leaf Disease :

The plant's color, shape, and function may vary as it responds to the illness. We'll go through the signs and symptoms of these illnesses, as well as what to check for if your plant's development appears to be slow. The appropriate classification and diagnosis of leaf diseases are crucial for reducing agricultural losses. Different plant leaves transmit various diseases and show multiple symptoms.

Leaf Spot on Septoria:

One of the most prevalent tomato plant leaf diseases is the septoria leaf spot. A tiny, round patch with a greyish-white center and black borders is the first sign of this fungus' presence. In the center, tiny black specks may appear. The leaves of sensitive tomato plants become yellow, wither, and fall off due to prolonged exposure to hot, humid conditions.

Early Blight (Alternaria):

Alternaria is a parasite that causes tomato leaf spots and an early curse. On the lower leaves, brown or dark regions with dim edges arise, practically like an objective. Organic product stem closes are exceptionally touchy, creating tremendous, profound dark blotches with concentric rings. A fungus causes this tomato plant disease, which appears after the plants have produced fruit.

Blight in the Late Stages:

Late blight, a tomato plant disease caused by the fungus Phytophthora infestans, arises in perfect, wet conditions after the growth season. Frost damage with uneven green-black splotches emerges on plants. Fruits with large, irregularly shaped black areas can quickly be destroyed. This fungus, which causes tomato plant disease, also affects potatoes and can be transmitted through them. The same precautions should be used as with septoria leaf spot.

Problem Definition

In terms of agriculture preservation, our farmers have to check the leaves and illness of the plants by getting the sample itself or checking on the field. There might be a shot at blunder because of the absence of information and numerous different variables. So we need to automate this with the goal that farmers can rapidly build their creation.

This research aims to use a transfer learning inception v3 model that has previously been trained on a significant quantity of data to identify disease in tomato leaves autonomously.

Objectives

Tomatoes are the most extensively planted vegetable crop in India's agricultural lands. Although the tropical environment is favourable for its growth, specific climatic conditions and other variables influence tomato plant growth. In addition to these environmental circumstances and natural disasters, plant disease is a severe agricultural production issue that results in economic loss. Therefore, early illness detection can provide better outcomes than current detection algorithms. As a result, deep learning approaches based on computer vision might be used to detect diseases early. This study thoroughly examines the disease categorization and detection strategies used to identify tomato leaf diseases. The pros and limitations of the approaches provided are also discussed in this study. Finally, employing hybrid deep-learning architecture, this research provides an early disease detection approach for detecting tomato leaf disease.

Methodology

Deep learning increased the learning capacity of the features directly in highly dimensional unprocessed s data, the deep learning algorithms in images and extraction of specific audio segments, and supervised learning in general. Hence, as a strong candidate for classification task modulation, an integrated understanding of deep Learning algorithms solves the central problem as the characteristics of the samples are selected and extracted. Therefore, it shows the combination of simple functions in more efficient and more complex features to achieve the classification more efficiently and complicated. Moreover, deep neural

The architecture of DCNN is as follows:

We developed "IDENTIFICATION of tomato leaf disease using transfer learning" using Deep learning. We just took a step and started to collect lots of images of crop leaves. We require space capability to get the correct information. Then, at that point, we pick which calculation is ideal for tackling this issue, and we choose "Convolution Neural Network" not surprisingly (CNN). Be that as it may, we gain less precision utilizing move learning engineering, which admirably prepares and tests datasets.

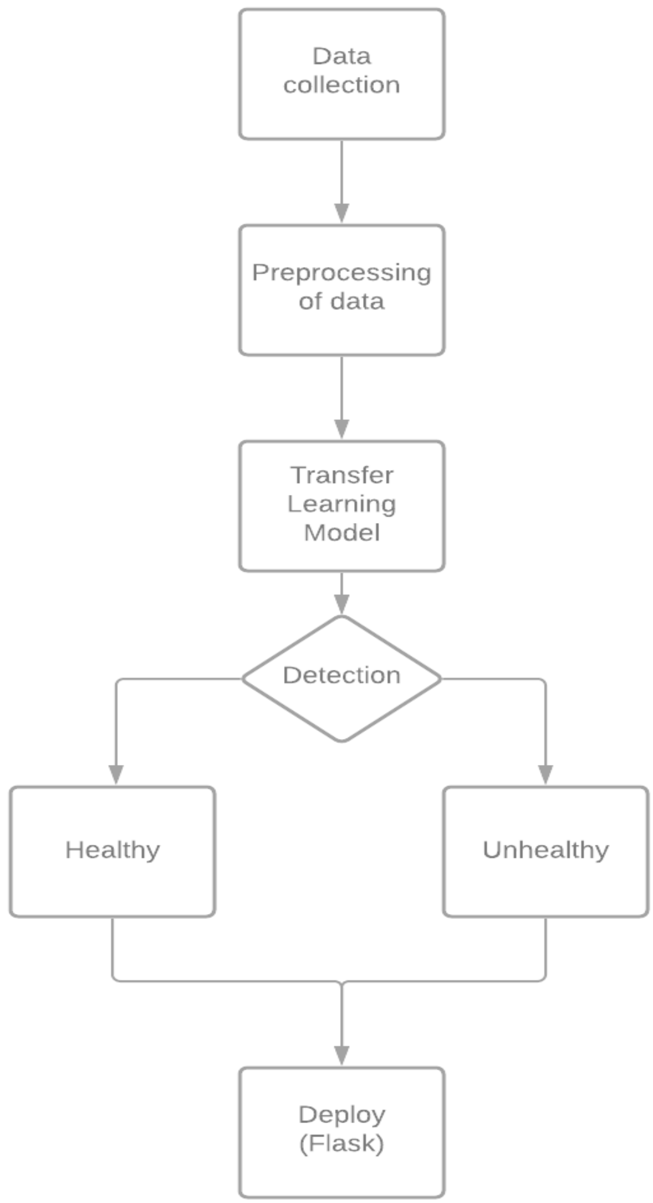

Fig Proposed Methodology of the system

Transfer Learning

Transfer learning is the practice of reusing a previously learned model for a replacement task; it is popular in deep learning since it allows deep neural networks to be trained with a small amount of data. It is instrumental in data science because most real problems do not have many data points marked to coach these complex models. Let us look at transfer learning, how it works, why it is valid, and when it should be used. Several resources for models who have been previously trained in learning transfers are included.

The general idea behind transfer learning is to apply knowledge obtained from projects with many marked data to situations where just-named data is available. Because creating named data is expensive, it is critical to make use of existing datasets whenever possible. The primary goal of a standard machine learning model is to summarise inconspicuous information based on designs derived from preparation data. You use transfer learning to begin this speculative encounter by starting with strategies learned for a separate mission. Essentially, instead of starting the taking-in process with a (usually randomly introduced) transparent sheet, you start with designs that have been planned out to answer an alternate assignment.

Although deep learning is frequently employed in research, many real-world situations lack a large number of named data points on which to create a model. To tune the high number of boundaries in neuronal architecture, profound learning approaches need large amounts of data. This necessitates a large amount of (expensive) labeled information, especially in the case of controlled learning. Although it may seem minor, master information is required to create a large named dataset in Natural Language Processing (NLP).

Transfer learning has both advantages and disadvantages. Understanding these drawbacks is critical for successful AI applications. Information transfer is only possible when it is 'appropriate.' It's difficult to determine the best approaches in this case, so you'll have to try a lot.

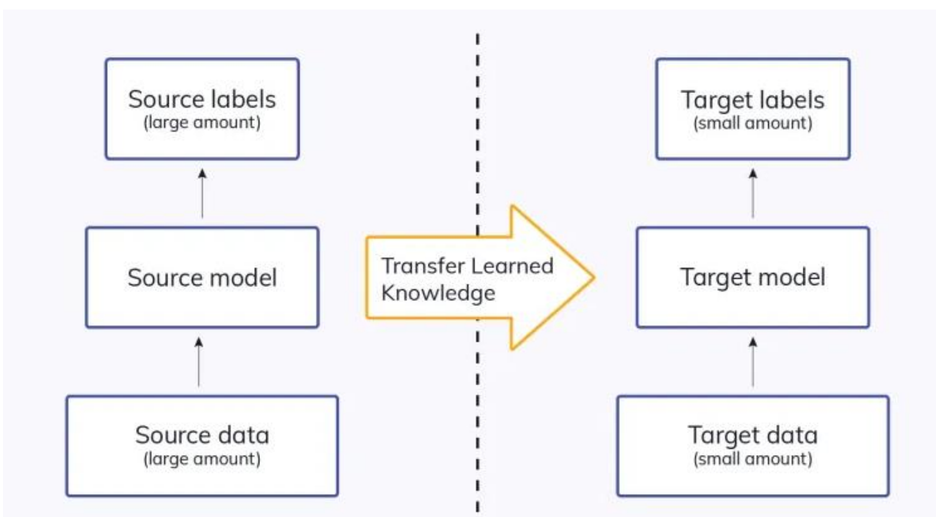

Fig 3.2 Transfer Learning [14]

Commonly used Transfer Learning Models.

Now we will look at some of the most popular and widely utilized transfer learning models. The majority of the models we will talk about later are employed in picture categorization.

Inception

Szegedy proposed the Inception microarchitecture in their work Going deeper with Convolution in 2014. The whole architecture with dimension reduction looks like this:

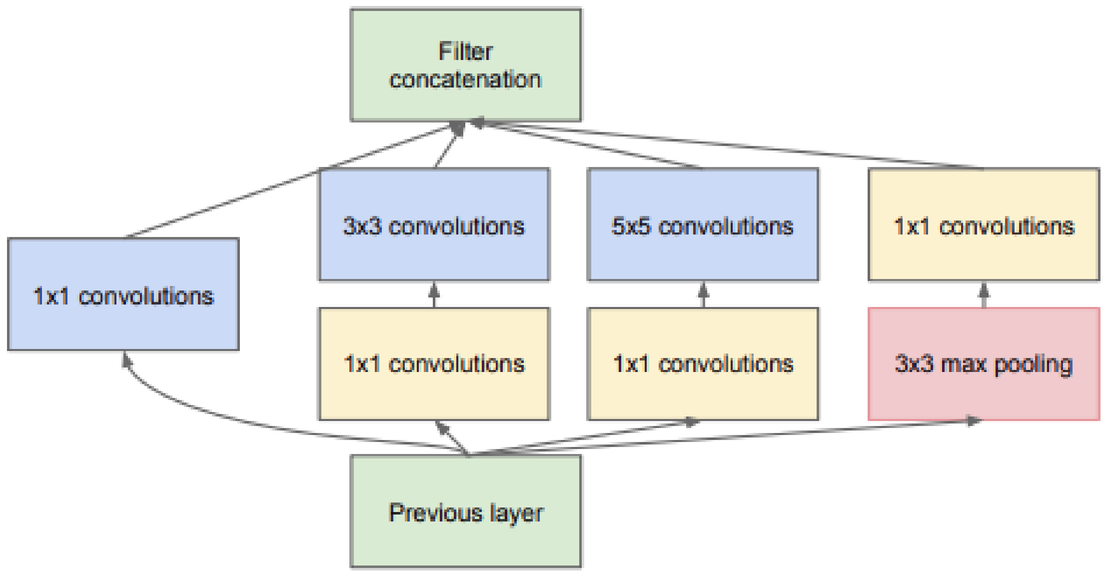

Fig . Inception Model

This module operates as a multi-level feature extractor by computing convolution levels 11, 33, and 55.

Large Categories' Image Classifier Inception v3:

Inception-v3, a 48-layer deep pre-trained convolutional neural network, is a version of the network that has previously been trained on over a million pictures from the ImageNet collection. This organization has also been pre-programmed to classify images into 1000 distinct object categories, such as consoles, mice, pencils, and other critters. As a result, the company has acquired a wide range of rich component depictions for various films. In the first stage, the model collects generic characteristics from input photos and then classifies them using those features in the second portion. On the ImageNet dataset, Inception v3 has been demonstrated to achieve better than 78.1% accuracy and roughly 93.9% accuracy in the top 5 results. The model represents the result of several concepts explored over time by several scholars.

Data Analysis

We gathered the data from Kaggle for the evaluation to detect the tomato leaf illness so that improvement can be made before any lasting harm occurs. In the dataset, there are 21,416 total images in the dataset which we have divided into training dataset of 18,345 & 3,071 images in testing.

Now, the dataset is divided into two parts: one is large set which we used to train the inception model (Transfer learning), and another group is used to test the model. Here, we have divided the data in 80/20 ratio, i.e., 80% for training and 20% testing.

The model training is done with the Keras with TensorFlow as a deep learning library using a TITAN RTX 24G GPU. The Adam optimizer used for the architectures, and the loss function was the categorical cross-entropy function. We used ReLU activation functions for all layers, except the last dense layer, using sigmoid activation functions. We have trained the model up to 20 epochs & we achieved 87.69% Accuracy of model.

Training the Model

For example, in computer vision, neural networks often attempt to detect edges in earlier layers, shapes within the middle layer, and a few features specific to tasks within the following layers. Second grade. It helps leverage the labeled data of the job that it had been trained initially. The model has learned to acknowledge objects, so we'll only retrain the subsequent layers. We attempt to transfer the maximum amount of knowledge possible from the trained model's previous task during transfer learning. This data can take many various forms counting on the matter and therefore the data. For instance, it might be how models are constructed, allowing us to define new objects more easily. Tons of knowledge are required to coach a neural network from scratch but not always have access to that data available - this is often where transfer learning becomes useful. Because the model has been trained beforehand, this is often especially valuable in natural language processing since most of the expertise is required to make large-labeled datasets. Also, training time is reduced because it can sometimes take days or maybe weeks to coach a deep neural network from scratch for a task. After training, true-positive, false-positive, true-negative, false-negative of the test set were recorded successively.

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