IDENTIFICATION OF PLANT LEAF DISEASE DETECTION

Sneha.S , Sai Jaya Sri.K , Jasmine.AK, Vinish Alikkal
Rathinam college of Arts and Science
Coimbatore,tamil Nadu

Abstract

The majority of the world's food supply comes from plants. Crop disease is a serious problem since it significantly lowers the pace of food production. Plant diseases are a factor in productivity loss, although they may be controlled with ongoing observation. Monitoring plant diseases manually is time-consuming and prone to mistakes. One technique for determining whether a plant has a certain illness is to use a CNN (Convolution Neural Network), which works by taking a photo of the plant's leaves and feeding it to a model to determine the findings.

We are using image processing with a convolution neural network (CNN) to identify plant illnesses. A convolutional neural network (CNN) is a type of artificial neural network that is used in image recognition and is especially designed to analyse pixel input. the YOLO the Most Effective Object Detection Method deliver quicker AI vision. When performing image recognition tasks, an object detector uses an object detection method that predicts bounding boxes and class probabilities for each item in the input picture. The majority of methods extract characteristics from the picture to estimate the likelihood of the learnt classes using a convolutional neural network (CNN).

Keywords—CNN, YOLO, Plant disease detection, Pytorch.

I. Introduction

Agriculture has always been a major economic driver in developing countries. To make the people of our nation economically strong and prosperous, we must harvest excellent quality and quantity from agriculture. Each year, extreme weather, viruses, and several crop diseases cause significant agricultural loss. Emerging plant and agricultural diseases are commonly overlooked by farmers. As a result, certain viruses or illnesses are not specially addressed in plants.

A strong deep learning package from Google called Tensor Flow is utilised in numerous industries, including agriculture. In large-scale agricultural contexts, it may be utilised as a useful tool for monitoring, spotting, and diagnosing plant diseases. We will examine the development of a computer vision-based automated plant disease detection system using Tensor Flow.

Gathering training data is the initial stage in utilising Tensor Flow to build a solution. photos of both healthy and sick plants, as well as photos with varying degrees of disease severity, should be included in this data. The following phase is to develop a neural network that can recognise sick crops. The information gathered in step one may be used to train this model. After training, the model may be used to identify plant diseases in any picture.

Making a monitoring system that can notify users when plant diseases are found is the next stage. This technology need to be able to distinguish between healthy and ill plants and notify the farmer right away. We must harvest agricultural products of exceptional quality and quantity to remain strong and thriving economically. Extreme weather, viruses, and a number of crop diseases contribute significantly to annual agricultural losses. Farmers frequently ignore new illnesses affecting plants and other agricultural organisms. Because of this, certain diseases or illnesses do not require unique treatment in plants. To stay powerful and economically prosperous, we must harvest agricultural goods of extraordinary quality and quantity. The annual losses in agriculture are largely caused by extreme weather, viruses, and other crop diseases. New diseases that harm plants and other agricultural creatures are routinely disregarded by farmers. Because of this, some diseases or conditions in plants don't require special care. A strong deep learning toolbox from Google called Tensor Flow is utilised in numerous industries, including agriculture. In large-scale agricultural contexts, it might be a useful tool for monitoring, recognising, and diagnosing plant diseases. We will examine the development of an automated plant disease detection system using Tensor Flow.

II. In order to grow and prosper economically, we must harvest agricultural goods of remarkable quality and quantity. The annual losses in agriculture are largely caused by extreme weather, viruses, and other crop diseases. New diseases that harm plants and other agricultural creatures are

routinely disregarded by farmers.Because of this, some diseases or conditions in plants don't require special care. Many industries, including agriculture, employ google's potent deep learning toolset Tensor Flow. In large-scale agricultural contexts, it might be a useful tool for monitoring, recognising, and diagnosing plant diseases.

II. METHODS

1. Related Work

For the categorization of tomato leaf diseases, Kibriya et al. (2021) employed VGG16 and GoogLeNet. On the Plant Village dataset, which included 10735 single leaf pictures against a plain backdrop, VGG16 achieved 98% accuracy and GoogLeNet 99.23%. On the Plant Village dataset, Karthik et al. (2020) used residual learning and attention mechanisms to learn important characteristics for classification and obtained an accuracy of 98%. In contrast to, Barbedo (2019) investigated the use of specific lesions and locations for the job.

III. PROPOSED SYSTEM

3.1. Data Preparation :

Data gathering: Compile a sizable database of pictures of both healthy and sick plants of diverse types. The deep learning model will be trained and evaluated using this dataset.

Image pre-processing: To enhance the performance of the model, conduct the appropriate pre-processing operations on the gathered photos, such as cropping, resizing, normalisation, and data augmentation. Split the obtained data into training, validation, and test sets as part of the data preparation process. This will be used to train the deep learning model, assess its effectiveness, and test it using fresh data that hasn't been used before. Label the photos in the dataset as either healthy or ill so that the deep learning model may learn from the labels.. Data conversion: Put the labels and pictures into a format that TensorFlow can accept as input. It may be necessary to do this by encoding the labels as one-hot vectors and transforming the pictures into a numerical tensor. Data normalisation: Scale the numbers to have a mean of 0 and a standard deviation of 1 in order to normalise the input data. The deep learning model will perform better and converge more quickly as a result of this. Before each training session, shuffle the data to prevent overfitting and boost the model's performance.

Some images from dataset:

Figure 1

Figure 2

3.2 Image Classification:

In order to automatically categorise photos of plants based on their symptoms and determine the existence of a disease, image classification in plant disease detection uses computer vision and machine learning techniques. This is often accomplished by instructing a Convolutional Neural Network (CNN) on a sizable collection of pictures, which contains instances of both healthy and sick plants. A predicted class or classes for the picture are produced by the CNN after processing the image through numerous layers of convolution, pooling, and activation. The parameters of the model are modified during training in order to reduce the difference between the predicted class and the actual class of the picture.following model training, It may be used to categorise fresh plant photos into several kinds of illness. This can be helpful for early disease diagnosis and enables farmers to take the necessary precautions to stop the illness's spread.In general, image classification is essential for automating the disease detection process for plants and has the potential to increase the precision and effectiveness of disease diagnosis.

3.3 Data Processing:

Data preprocessing, which involves cleaning and modifying the data so that it can be efficiently utilised for analysis and modelling, is a crucial stage in the identification of plant diseases. Data preparation is important to make sure that the labels and pictures are in the right format for processing and analysis, and it can help the plant disease detection model perform better. The following are some typical procedures in data preparation for spotting plant diseases.
Image Resizing: The photos might need to be scaled to a standard size since they may have varied dimensions that prevent the CNN from processing them.
Data Augmentation: By using methods like rotations, flips, and colour modifications on the photos, the training dataset may be expanded. This can lessen overfitting and increase the model's resilience.Split into Train and Test Datasets: The dataset should be split into

two parts, with a portion used for training the model and the remaining portion used for testing the model. Label Encoding: In order for machine learning algorithms to process the classes or labels of the pictures, they must be encoded as numerical values. Divide the Dataset into Train and Test Sets: The dataset should be divided into two sets, one for training the model and the other for testing it.

3.4 Convolutional Neural Network:

Plant disease diagnosis using CNN is possible. Based on pictures of the plants, they have been effective in correctly categorising plant illnesses. Colour, texture, and form attributes from plant photos may be automatically extracted using CNNs and used for categorization. This eliminates the need for labor-intensive and arbitrary manual feature extraction. Without manual feature extraction, CNNs can classify plant illnesses straight from the raw photos. This increases the automation and effectiveness of the categorization process. CNNs can withstand changes in illumination, picture orientation, and other elements that may have an impact on how plants appear in photos. Because of this, they may be used in practical applications. A new dataset can be used to finetune trained CNN models., It might be more efficient in terms of time and resources than training a model from start. This is especially helpful when there is a shortage of labelled data. Comparatively to other approaches, such as conventional machine learning algorithms, CNNs havedemonstrated great accuracy in the categorization of plantdiseases. They are therefore a wellliked option for identifying plant diseases.

3.5 Pytorch:

By creating and training a neural network model with PyTorch, one may use it to reliably categorise photos of plants and find any signs of disease. The following actions can be made to use PyTorch to create a plant disease detection modelGather and prepare the data: Gather a collection of pictures of plants with both healthy and sickly leaves. Then, perform any necessary image augmentation procedures to expand the dataset, resize the images to a standard size, and normalise the pixel values. Divide the dataset into three sets: a training set, a validation set, and a testing set. The validation set is used to check the model's performance while it is being trained and to make any necessary hyperparameter adjustments. The testing set is used to assess the model's final performance.Create the neural network architecture that will be used to classify the photos. Define the model architecture. The PyTorch nn module, which offers pre-built layers including convolutional layers, pooling layers, and fully linked layers, can be used for this. Develop the model: Use a suitable loss function (such the mean squared error or cross-entropy loss) to train the YOLO model on the training set.Analyse the model: Check how the trained YOLO model performed on the validation set, and make any necessary changes to the model's hyperparameters.Analyse the model: Test the finished model on the test set to gauge how well it can identify plant diseases.

3.6 YOLO V7:

A real-time object detection technique called YOLO (You Only Look Once) employs deep learning to recognise items in a picture. In order to determine the item class and position for each grid cell, the algorithm divides the picture into a grid.

Some of the important ideas discussed by YOLO include the following:

The main application of YOLO is for object detection. It has the ability to recognise and find things inside an image and categorise them into different groups. Deep Learning: YOLO makes advantage of deep learning, a branch of machine learning that entails putting artificial neural networks through a variety of exercises.

Convolutional Neural Networks (CNN): YOLO employs a CNN architecture to identify objects and extract characteristics from photos.

Anchors: YOLO uses anchor boxes to predict the location of objects within an image. Anchors are predefined bounding boxes of different sizes and aspect ratios.

Non-maximum suppression (NMS): YOLO uses NMS to remove duplicate detections and output only the most probable ones.

Loss functions: YOLO uses a loss function to measure the difference between the predicted and actual values during training.

Darknet: YOLO is implemented using the Darknet framework, which is a neural network framework written in C and CUDA.

3.7 Model Training:

Image Pre-processing: Perform necessary pre-processing steps on the collected images, such as cropping, resizing, normalization, and data augmentation, to improve the performance of the model.

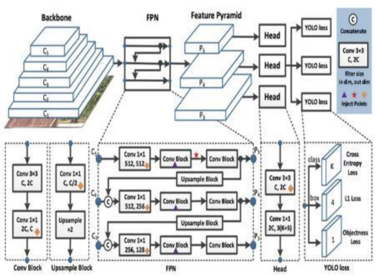
Model Design: Choose a suitable deep learning architecture, such as a Convolutional Neural Network (CNN), to classify the images as healthy or diseased.

Model Training :Train the model using the collected and pre-processed images.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 SJIF 2023: 8.176 ISSN: 2582-3930

Model Validation: Evaluate the performance of the trained model using techniques such as cross-validation, holdout validation, or bootstrapping, to ensure that it generalizes well to new unseen data.
Deployment: Deploy the model in a user-friendly interface, such as a web or mobile application, allowing farmers and researchers to easily classify new plant images as healthy or diseased.
Monitoring and Improvement:Continuously monitor the

rotation, flipping, and brightness/contrast adjustments to increase the diversity of the dataset.
Annotation: Mark up the photos with the bounding boxes for the plant diseases they include, along with the accompanying class names. The YOLO model will be trained using this annotation as the ground truth. Utilising the annotated dataset, train the YOLO model. This entails feeding the YOLO model the photos and their related annotations and then iteratively changing the model's



improvements to increase its accuracy and reliability over time.
Integration with Expert Systems:Integrate the deep learning-based system with expert systems and existing agricultural databases to provide a comprehensive solution for plant disease detection.

retrained with new data, its hyperparameters may need to be adjusted, or the model's architecture may need to be optimised for quick inference.
Testing and Maintenance: It's critical to routinely test and maintain the YOLO-based plant disease detection system to maintain its accuracy and dependability. For the model or its data to adapt to shifting circumstances and new illness

kinds, periodic updates may be necessary.
Glenn Jocher in 2020 introduced the one-stage target recognition method known as YOLOv5. YOLOv5 may be separated into four network model versions: YOLOv5s, YOLOv5m, YOLOv5l, and YOLOv5x, based on variations in network depth and breadth. The YOLOv5s network among them has the highest computation speed but the lowest average precision, whereas the YOLOv5x network exhibits the opposite traits. The YOLOv5 network's size is around one-tenth that of the YOLOv4 network. Its accuracy is on par with YOLOv4 and boasts quicker
performance of the deployed model and make necessary Figure 3 : Overview of proposed system.

3.8 Implementation details :

YOLO is a popular object detection algorithm that can be trained to detect and classify objects in images or videos, including plant diseases. Here's an overview of the steps involved:
Data Collection: Collect a dataset of images that contain healthy plant leaves as well as leaves with different types and severities of diseases. This dataset will be used for training and evaluation of the YOLO model.
Data Preprocessing: Preprocess the collected images by resizing them to a consistent resolution, normalizing pixel values, and augmenting the data with techniques such as

parameters to reduce detection errors. A strong GPU is needed for this phase to ensure effective training.. Use a different dataset that wasn't utilised for training to assess the learned YOLO model. This aids in evaluating the model's recall, accuracy, and other performance indicators.
Model Deployment: The YOLO model may be used to identify plant diseases in real time in a production setting after being trained and assessed. In order to do this, the trained model must be integrated into a programme or system that can analyse input photos using the YOLO model and output diagnosed plant illnesses along with their locations.
Fine-tuning and optimisation may be necessary to further boost the deployed model's accuracy and effectiveness, depending on how it performs. The model may need to be identification and placement rates. The Backbone, Neck,

and Head make up the three primary parts of the YOLOv5 network. Backbone gathers and creates picture characteristics based on various image granularities when the image is entered. Neck stitches followed. the image features and transmits them to the prediction layer, and Head predicts the image features to generate bounding boxes and predicted categories. The YOLOv5 network uses GIOU as the network loss function, as shown in Equation.

GIOU=IOU−|C−(A∪B)||C| where A,B⊆S⊆Rn represent two arbitrary boxes, C represents the smallest convex box, C⊆S⊆Rn, enclosing both A and B and IOU=|A∩B|/|A∪B| When the input network predicts image features, the optimal target frame is filtered by combining the loss function GIOU and the nonmaximum suppression algorithm.

IV.CONCLUSION

This paper summarises the application of artificial intelligence and convolutional neural networks for the detection of plant diseases utilising the powerful tool TensorFlow. We can enhance the model even further by training it on more images. We may also update the model and include new varieties of plant diseases. The use of more Natural Language Processing to illnesses can produce recommendations, treatments, drugs, and sprays. The objective of this study is to create a Tensorflow-based technique for identifying plant leaf diseases. The suggested approach may accurately diagnose illnesses by using developments in machine learning methods. The algorithm extracts information from photos of plant leaves using a convolutional neural network (CNN) and then classifies these features into different groups. Results show that the model accurately predicts illnesses when tested on a real-world dataset. The agriculture business may undergo a revolution as a result of this research, which offers a possible remedy for identifying plant leaf diseases. The results of this study might also serve as a springboard for creating a more complex system to identify illnesses in a range of plants and crops.

V.FUTURE WORK

Plant ailments have the power to destroy crops and cause large crop losses. The necessity for efficient techniques of identifying and managing plant diseases becomes progressively more crucial as the world population and food demand rise. Early identification of plant diseases using artificial intelligence and machine learning approaches has grown in importance as a study area. Deep learning innovations in recent years have significantly increased computer vision model accuracy and created new opportunities for the autonomous diagnosis of plant diseases. With no requirement for manual feature selection, deep learning models are highly suited to this task since they can identify various plant diseases from photos.
Researchers will keep investigating new and enhanced deep learning models in the future to more accurately identify additional plant illnesses. It is envisaged that additional advancements in this area would make prompt and precise plant disease detection more prevalent, improving agricultural yields and reducing plant diseaserelated losses. Diseases in Leaves Tomato Detection Using Image Processing Roksana Akter Shampa, Tahmina Tashrif Mim, Md. Helal Sheikh, Md. Shamim Reza, and Md. Sanzidul IslamUsing natural language processing (NLP), diagnose plant leaf ailments. Using NLP, a potent machine learning technology, it is possible to find patterns in text that might point to the existence of particular illnesses. The model may be used to predict if a certain document has any content that refers to the leaf disease. Plant farmers will therefore be able to swiftly and precisely identify any possible leaf illnesses using the model's automatic detection of leaf diseases.

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