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Plant Leaf Disease Detectionusing Machine Learning

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***Abstract:** A crucial component of describing plants for tracking plant growth is plant phenotyping. In this research, an effective method for identifying healthy, damaged, or infected leaves utilising image processing and machine learning approaches is presented. Many illnesses deplete the chlorophyll of brown or black markings appear on the leaf area of the leaves. They can be found out utilising machine learning methods for classification, feature extraction, picture preprocessing, and image segmentation. Grey Level Co-occurrence Matrix (GLCM) is used for feature extraction. One of themachine learning techniques used for classification is called the Support Vector Machine (SVM). When compared to the SVM method, the Convolutional Neural Network (CNN) produced better recognition accuracy. Finding disease on crops is a crucial responsibility in agricultural techniques.*
***Keywords:** Machine Learning, SVM, CNN.*

I. INTRODUCTION

Agriculture is notable in India because it is a developing nation. Almost 58% of rural India's livelihood is influenced by agriculture. One of the most often used agricultural items is the tomato. Thus, preventing a severereduction in tomato production and quantity reliant in large part on the identification and classification of any diseases that a tomato plant may have.

By utilising various sorts of techniques and algorithms, such as image processing, the most recent and advancing technologies are applied to address such problems. When a tomato plant contracts a certain type of disease, the leaves are first affected. The research uses four sequentialsteps to identify the type of sickness. Pre-processing, leaf segmentation, feature extraction, and classification are thefour steps. eliminating the noise A plant disease symptom is a disease's outward manifestationin the plant. A noticeable alteration in the plant's colour, shape, or functionality as a result of the disease is one of the symptoms. Leaf Wilting is a typical sign of the fungal plant diseases Verticillium albo-atrum and V. dahliae, which causeverticilium wilt. Brown, necrotic lesions with a brilliant yellow halo at the leaf margin or inside the leaf are typical signs of bacterial blight on bean plants. Instead of the illness pathogen itself, you are actually viewing a symptom that the infection is causing. indications of fungal disease:

Sclerotinia; • Leaf rust (common leaf rust in corn); • Stemrust (wheat stem rust); (white mold) Particulate mildew Symptoms of a fungus: • Birds-eye spot on

A. The Technology Behind plan prediction

Beyond the integrity of data, Machine Learningtechniquesmainly target, to allow software applications to become more accurate for the prediction of outcomes without being explicitlyprogrammed. For input, Machine Learning mainly use the pre-used data for the output values prediction.The reason is majorly that it can solve issues in effective speed and on the scale that cannot be achieved by the mind of human alone, ML has proved to be useful for this. Machines can be carefully trained to recognize patterns in and correlations between the incoming data by establishing relationships between the immense computational power behind the single activity or various other particular tasks. This allows machines to perform various process in repetitive manner.

The objective of the provided paper is to search that to what extent machine learning enhance the prediction result with accuracy and information across the various different sources. For the conclusion of the prediction with higher accuracy, in this paper linear and lasso regression is used: which provides the higher accuracy as compared to other algorithm of machine learning. Once a prediction rate of the disease has been achieved by the medical department, then further safetymeasures can be achieved.

B. Steps Used

1) Dataset Classification

It's important to choose the right set of images for the model's training. To get specific photos, the centroid of each image is determined.Contours can be used to compute the centroid. A contour is a curve that connects each point on a shape's edge.

Contour can be very precisely recognised on binary pictures. This function takes three arguments: the source image, the contour retrieval mode, and the contour approximation technique. The function's output includes the photos, contours, and hierarchy. All image contours are included in the output.
Every contour is an array of boundary point (x, y) coordinates. The coordinates to be stored are specified using the contour approximation method. All boundary points are stored in CHAIN APPROX NONE. Because only two points are required to determine the contour of a straight line, all points are not necessary. This type of output is produced by CHAIN APPROXSIMPLE by compressing the contour and removing all unnecessary points.

2) Building the CNN using transfer learning

With the introduction of Convolutional Neural Networks, image identification has become possible. Yet, creating a CNN that recognises things and categorises them into several groups is a challenging undertaking.
It can be streamlined by utilising transfer learning.
It is one of the most popular models for categorising images. Convolutions are factorised in order to reduce network parameters and connections while maintaining network performance.

3) Training our Network

It trains a new layer that is responsible for classifying the specifically designated custom classes. Variables like image dir, intermediate output graphs dir, output graph, output labels, distortion feature, number of training steps (epoches), learningrate, etc. can be changed in the script. The path to these foldersis given to the retrain script, and the dataset contains labelledfolders with photos. These photos are kept in part for testing. Iteratively training the Inception v3 model over several batches for a predetermined amount of epochs. For testing, a different group of photos is set aside. In order to get statistics during model training, callback functions are employed.
Callbacks are used to retrieve parameters such as loss, validation loss, and accuracy. Via various methods, we keepan eye on the model's performance using these parameters.

4) Testing

A set of photos are used to test the trained model. The networkis fed with random images, and the output label is compared to the image's original, well-known label. factors that are employed in evaluation are the F1 score, recall, and precision.The percentage of correctly predicted positives is known as precision. The proportion of actual positives that were correctly classified is provided by recall. The F1 score aids inpreserving a balance between recall and precision. Surveys conducted using GBD provide evidence for the necessity for such developments. Several authors have published a variety of studies on relevant topics.Callbacks are used to retrieve

C. Software Requirement Proprieties

Python 3.6.0 is a dynamic object-oriented programming language that may be applied to varieties of software development projects. It comes with extensive standard libraries, strong support for integration with other languages and technologies. Many Python developers claim to have seen considerable boosts in productivity and they have felt as if the language encourages the production of higher quality, more maintainable code.
Jupyter Notebook: A client-server program that mainly allow us to makes edit and run notebook papers by the web browser is known as the Jupyter Notebook App. The Jupyter Notebook App can also be deployed on the remote server and can be accessed through the help of internet, or it can be run on the desktop without the need for any kind of internet connection. TheApp contains a "Dashboard" , a "control panel" that exposes local files and allows to open or shutting down their kernel in addition to displaying, editing, and running notebook documents.

II. LITERATURE REVIEW

According to the research that follows, farmers in rural areas may believe that it is difficult to distinguish between illnesses that might affect their harvests. Our goal is to identify the disease that is introduced in a plant by observing its shape using image processing and machine learning. Pests and diseases cause crops or parts of plants to be destroyed, which lowers food output and increases food insecurity. Also,little is known about diseases and pest management or controlin many less developed nations. One of the main causes of decreased food production is toxic pathogens, poor disease control, and dramatic climate changes.

In order to reduce post-harvest processing, increase agricultural sustainability, and limit environmental impact, a number of contemporary technologies have arisen.

For identifying diseases, a variety of laboratory-based methods have been used, including polymerase chain reaction, gas chromatography, mass spectrometry, thermography, and hyperspectral techniques.

These methods take a lot of time and are not very cost- effective. In the recent past, disease identification has been done using server-based and mobile-based approaches.Automatic disease recognition is made possible by a number of elements, including the high resolution camera, high performance processing, and numerous built-in accessories. The accuracy of the results has been improved by using contemporary methods like machine learning and deep learning algorithms. Several studies in the area of machine learning for plant disease detection and diagnosis, include conventional machine methodology including fuzzy logic, K-means, convolutional neural networks, support vector machines (SVM), random forest, etc.

They suggested random forests, which function by building a forest of decision trees throughout the training period, as a learning method for classification, regression, and other tasks.

Unlike decision trees, random forests handle both categorical and numeric data and overcome the drawback of overfitting their training data set. Contributions are made in three stages for the structure mentioned above. To maximise the quality and segment the leaf samples, HE and K-means clusteringare first used. The K-means clustering response can be used to predict whether a leaf is infected or not at an early stage of operation. Furthermore, in order to extract the informative regions and characteristics of the samples, we apply the DWT, PCA, and GLCM. Finally, to categorise the characteristics using machine learning methods, SVM, KNN, and CNN are used.

III. PROPOSED METHODOLOGY

With the use of machine learning (ML), which is a form of artificial intelligence (AI), software programmes can predict outcomes more accurately without having to be explicitly instructed to do so.

In order to forecast new output values, machine learningalgorithms use historical data as input.

Machine learning is frequently used in recommendation engines. Fraud detection, spam filtering, malware threat detection, business process automation (BPA), and predictive maintenance are among further common uses. Machine learning is employed in many different applications nowadays. The recommendation engine that drives Facebook's news feed is arguably one of the most well-known applications of machine learning.

A. CNN

CNN : A convolutional neural network, or CNN, is a deep learning neural network sketched for processing structured arrays of data such as portrayals.CNN are very satisfactory at picking up on design in the input image, such as lines, gradients, circles, or even eyes and faces. This characteristic that makes convolutional neural network so robust for computer vision

CNN can run directly on a underdone image and do not need any preprocessing. A convolutional neural network is a feed forward neural network, seldom with up to 20. The strength ofa convolutional neural network comes from a particular kind of layer called the convolutional layer. CNN contains many convolutional layers assembled on top of each other, each one competent of recognizing more sophisticated shapes. Withthree or four convolutional layers it is viable to recognize handwritten digits and with 25 layers it is possible to differentiate human faces. The agenda for this sphere is to activate machines to view the world as humans do, perceive it in a alike fashion and even use the knowledge for a multitude of duty such as image and video recognition, image inspectionand classification, media recreation, recommendation systems,natural language processing, etc.

IV. RESULT ANALYSIS

Climate change and sustainable agriculture are both issues that are directly tied to the issue of effective plant disease protection. According to research, climate change might modify phases and rates of pathogen development; it can also change the host's resistance, which affects how the host and pathogen interact physiologically. The fact that infections are spread throughout theglobe more readily than ever before further complicates the matter. Inherently, new diseases can appear where no one has previously seen them and where there is no local knowledge to treat them. Inexperienced pesticide use can lead to the pathogensdeveloping long-term resistance, greatly limiting their ability to defend themselves. One of the foundational elements of precision agriculture is the prompt and precise identification of plant diseases. modern methods to boost the success rate of recognition and the precision of the outcomes, techniques like machine learning and deep learning algorithms have been used.

For the detection and diagnosis of plant diseases, numerous studies have beenconducted using classic machine learning techniques such random forests, artificial neural networks, support vector machines (SVM), fuzzy logic, K-means method, and convolutional neural networks, among others. Several users can view various diseases thanks to this same project.

Several procedures must be carried out in order to determine if the leaf is healthy or diseased. Pre-processing involves reducing all of the photos' sizes to a single, uniform value. The next step isto extract features from a pre-processed image, which is accomplished by HOG. HoG is an object feature descriptor detection. The appearance of the object and the outline of the image are characterised by the gradients in this feature descriptor.

V. FUTURE SCOPE

We have utilised a variety of classification algorithms, including Linear Regression, Random Forest, Logistic Regression. In the future, we can be able to add additional algorithm inorder for the identification of outputs, and the methods can also be compared to determine which algorithm produces the model with the highest computed accuracy. We can also add-on a visitor enquiry module, where users may post questions to the administrators and the administrators can respond. An Android app can be created as a user interface for communicating with users. We intend to carefully craft deep learning network topologies, and employ adaptive learning rates, to train on data clusters rather than the entire dataset for better performance. We can also use more sophisticated machine learning methods, such as random forests, ensemble learning, which produces several decision/regression trees and significantly reducesoverfitting, to obtain even more accurate models.

VI. CONCLUSION

This suggests a CNN-based method for classifying plant diseases based on the leaves of affected plants. It takes a lot of work to create a high-efficiency neural network. Adaptive learning can be used to increase effectiveness. One of the models that can automatically categorise photos and can also be trained to recognise various classes is Inception v3. Hence, using Inception v3 can be essential for identifying plant diseases quickly and accurately. The training set can be selected to guarantee proper model training for all characteristics by employing dataset classification with the contour approach as well. In comparison to classifying the dataset at random, this offers better feature extraction. The methods outlined in the project were used to achieve the best results. So, with losses in agriculture can be decreased by putting these methods into action and implementing them.

We found some of the most significant problems and shortfalls in works that automatically detected agricultural illnesses using CNNs. We also offered recommendations and instructions on how to use CNNs implemented in practical applications to their fullest capacity. Many already-published CNN-based solutions aren't now usable in the field, mostly because they don't adhere to numerous key machine learning principles. The generalisation capacities for unknown data samples and/or imaging settings may be weak as a result of this lack of conformance, which limits the usefulness of the trained models. Yet, the research demonstrates the promise of deep learning methods for identifying crop illnesses. Their conclusions are undoubtedly encouraging for the creation of new agricultural instruments that might help produce food thatis more sustainably and securely.

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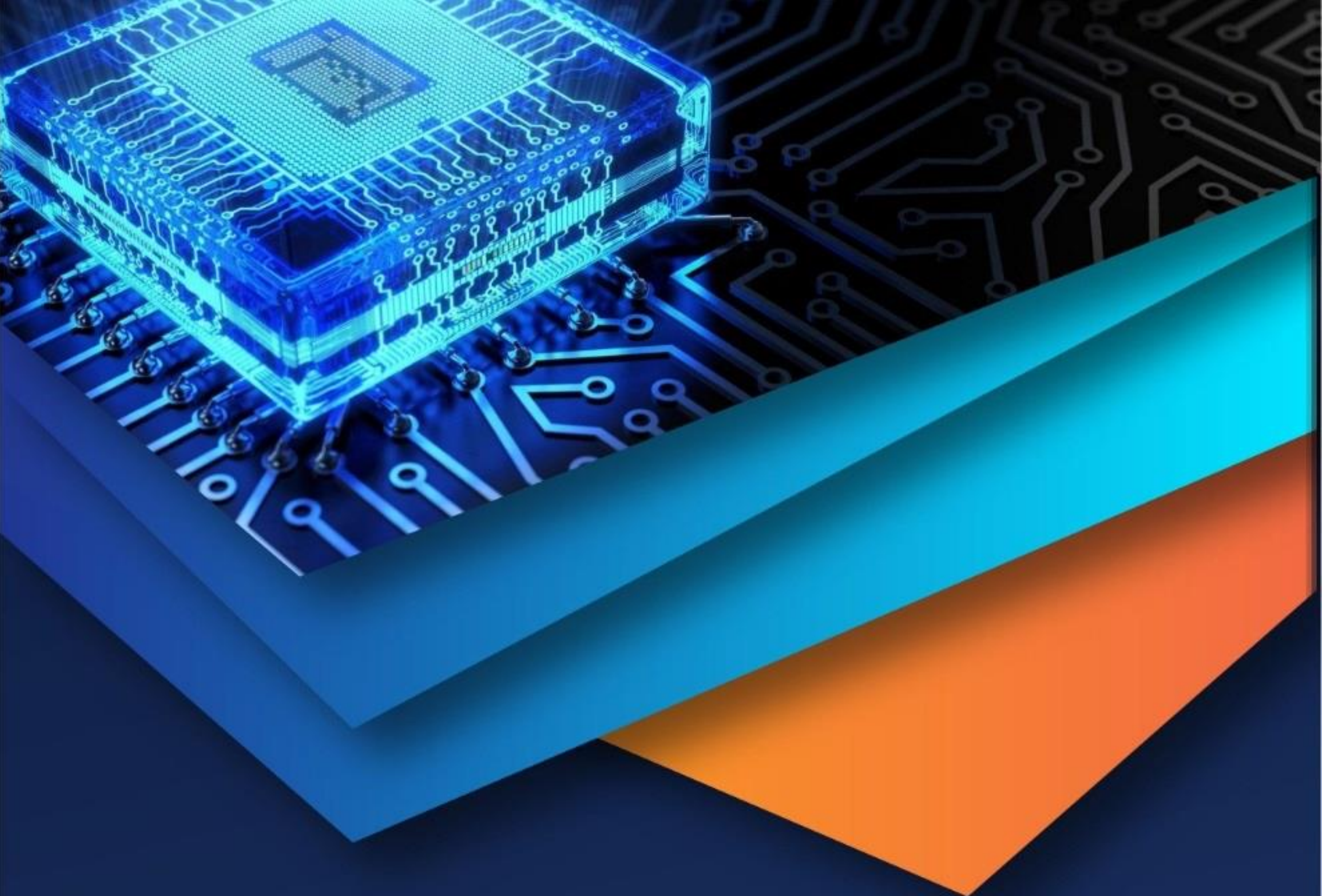

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