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A Review on Tomato Leaf Disease Detection Using CNN

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ABSTRACT: Crop diseases are key danger to food security. The speedy identification of the diseases is still difficult in many proportions of the world. This is because of lack of proper infrastructure. The tomato crop is an important staple in the Indian market with high commercial value and is produced in large quantities. Diseases are detrimental to the plant's health which in turn affects its growth. To ensure minimal losses to the cultivated crop, it is crucial to supervise its growth. There are numerous types of tomato diseases that target the crop's leaf at an alarming rate. This paper adopts a slight variation of the convolution neural network model called LeNet to detect and identify diseases in tomato leaves. The main aim of the proposed work is to find a solution to the problem of tomato leaf disease detection using the CNN. Now a day's smart phone usage is increased and computer vision technology is also increased. Because of this smart phone assisted disease identification is possible using Deep Learning. We are developing web application to identify the disease of leaf using CNN.

Public dataset contains 10000 images contains both infected and healthy tomato leaves. They are collected under controlled conditions. In the proposed method deep learning is used to detect the disease of the leaves. A deep convolution neural network model is trained to identify these diseases. In this we have used inception v3 model. The trained achieved 98.84% accuracy on the test dataset. This method is more feasible to detect the diseases in tomato leaves.

I. INTRODUCTION

With the development of modern ecological agriculture, more attention has been paid tocrop yield and quality. The incidence of crops has increased year by year, and the types of diseases have become more and more complicated. If only relying on professionals to observe the disease of crops with naked eyes in the planting area, it is easy to be affected by environmental factors and human factors, and it relies heavily on professional experience. More importantly, automatic monitoring and processing of diseases cannot be achieved. Therefore, it is particularly important to study more stable and efficient methods for the prevention and diagnosis of crop diseases.

In the application research of crop disease detection, traditional computer vision methods mostly need to segment leaf lesions, such as pixel-level segmentation, edge segmentation, region segmentation and multi-scale segmentation. Noise reduction, corrosion, enhancement and other techniques are applied to process image color space features and texture features, and then appropriate lesion features and classifiers are chosen for detection.

Plants are an integral part of our lives because they produce food and shield us from dangerous radiation. Without plants, no life is imaginable; they sustain all terrestrial life and defend the ozone layer, which filters ultraviolet radiations. Tomato is a food-rich plant, a consumable vegetable widely cultivated. Worldwide, there are approximately 160 million tons of tomatoes consumed annually.

The tomato, a significant contributor to reducing poverty, is seen as an income source for farm households. Tomatoes are one of the most nutrient-dense crops on the planet, and their cultivation and production have a significant impact on the agricultural economy. Not only is the tomato nutrient dense, but it also possesses pharmacological properties that protect against diseases such as hypertension, hepatitis, and gingival bleeding.

Tomato demand is also increasing as a result of its widespread use. According to statistics, small farmers produce more than 80% of agricultural output due to diseases and pests, about 50% of their crops are lost. The diseases and parasitic insects are the key factors impacting tomato growth, making it necessary to research the field crop disease diagnosis. The manual identification of pests and pathogens is inefficient and expensive. Therefore, it is necessary to provide automated AI image-based solutions to farmers. Images are being used and accepted as a reliable means of identifying disease in image-based computer vision applications due to the availability of appropriate software

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packages or tools. They process images using image processing, an intelligent image identification technology which increases image recognition efficiency, lowers costs, and improves recognition accuracy.

Some of the tomato leaf diseases are:

Early Blight:

This is a common disease of tomato occurring on the foliage at any stage of the growth. The fungus attacks the foliage causing characteristic leaf spots and blight. Early blight is first observed on the plants as small, black lesions mostly on the older foliage. Spots enlarge, and by the time they are one-fourth inch in diameter or larger, concentric rings in a bull's eye pattern can be seen in the center of the diseased area.

Late Blight:

The fast-spreading tomato plant disease is caused by the fungus Phytophthora infestans, and occurs during periods of cool, rainy weather that may come at the end of a growing season. It looks almost like frost damage on leaves, causing irregular green-black splotches. Fruits may have large, irregular-shaped brown blotches that quickly become rotten. This plant disease also affects potatoes and can be transferred from them.

Yellow Leaf curl:

Tomato yellow leaf curl virus (TYLCV) is not seed-borne but is transmitted by whiteflies. This disease is extremely damaging to fruit yield in both tomato and pepper crops. Whiteflies may bring the disease into the garden from infected weeds nearby, such as various nightshades and jimsonweed. After infection, tomato plants may be symptomless for as long as 2 to 3 weeks.

Leaf Mold:

The fungus Passalora fulva causes leaf mold. It is first observed on older leaves near the soil where air movement is poor and humidity is high. The initial symptoms are pale green or yellowish spots on the upper leaf surface, which enlarge and turn a distinctive yellow.

Under humid conditions, the spots on the lower leaf surfaces become covered with a gray, velvety growth of the spores produced by the fungus. When infection is severe, the spots coalesce, and the foliage is killed. Occasionally, the fungus attacks stems, blossoms and fruits. Green and mature fruit can have a black, leathery rot on the stem end.

Mosaic Virus:

Mosaic virus attacks many kinds of plants and is common in tomatoes. While mosaic virus doesn't kill the plant, it diminishes the number and quality of fruits. The virus gets its name from the markings that resemble a mosaic of light green and yellow on the leaves and mottling on the fruits of affected plants. Leaves may also grow in misshapen forms, resembling ferns.

II. LITERATUREREVIEW

[1] Srivastava A, Ma S, Inoue K. Development of a sensor for automatic detection of Downey mildew disease [J]. 2004:562– 567.

Downey mildew disease is the major disease of the Grape field. The fungus causes yield losses by decay or cause to decay by the action of premature defoliation of vines due to infections. The development of the disease is faster, within six hour the spread of the disease get multiplied by twice. Once it is affected it will diminish the quantity & quality of Grapes, it reduce the Photosynthesis process. In traditional system, farmer visually check the Environmental condition, if it is suitable for disease development then he applies pesticide spray on leaves of Grape field. In our proposed system we can prevent the Downey Mildew disease.

This system is electromechanical system. It takes Temperature & Humidity as an input. This is an automatic system, the farmer need not to check the disease visually. As soon as Environment condition matches for Disease development, the system will spray hot air & pesticide on the leaves of Grape field. The Grape field has roof like structure called a canopy. Hot air & pesticide is carried by pipes & sprayed by sprinklers. Hot air is created by using solar heater. Solar heater gives pressurized hot air. We spray hot air on leaves of Grape field, in order to resist development. Prevention is always better than cure. Instead of waiting for disease development, we can prevent this disease on Grape field. If disease is prevented then Export quality grapes can be produced & Farmer can have more profit from Grape production.

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[2] WANG S Z, HE D J, LI W, et al. Plant leaf disease identification based on kernel k-means clustering algorithm [J]. Agricultural machinery, 2009, 40(3):152-155.

The image processing is the technique which is applied to process the digital information from the images. The plant disease detection is the technique which is applied to detect disease from the input images. In this work, technique is applied which is based on textural feature extraction, segmentation and classification. The GLCM algorithm is applied which extracts textural features from the image. The k-mean clustering algorithm is used for the segmentation of input images. The SVM classifier is applied in the existing algorithm which will classify the input image into two classes.
To improve performance of existing algorithm the SVM classifier is replaced with KNN classification. This leads in an improved accuracy of disease detection, more over classify in the data into multiple classes.

The approach that we are implementing is k-mean clustering algorithm for segmentation. It is one of the popular methods used for segmentation. In this we divide the image into various clusters i.e. divides a set of data into specific number of groups. Data is classified into k number of disjoint sets.
A k-centroid is determined and then each point which has least distance from the centroid is taken into consideration. There are several ways of defining the distance of nearest centroid, one such method is Euclidean distance. Euclidean distance is calculated consecutively for each data point and the data point having the minimum distance is assigned to the cluster. These minimum points are summed up to get a centroid.

[3] WANG M L, NIU X J, ZHANG H M, et al. Research on feature extraction and recognition of common diseases of wheat leaf [J]. Computer Engineering and Applications, 2014, 50(7):154 –157.

In this project selects four common diseases of wheat leaf images, using image processing techniques to identify different types of disease.
Firstly, the RGB color space is converted to HSV color space, the relevant color characteristic hue and saturation are extracted, and then geometry features perimeter area, squareness, roundness, eccentricity, etc） are extracted. To obtain the eigen values of each disease range, the sample images are analyzed, and then the eigen values of the unknown samples are used to identify different kinds of wheat diseases.

This research takes powdery mildew and rust（leaf rust, stripe rust and stem rust) as research objects. Based on color characteristics, the powdery mildew and rust are identified, according to the shape characteristics, leaf rust, stripe rust and stem rust are identified. The proposed method is simple and convenient with an identification rate of more than 96%. The experimental results show that the chosen color and shape features of these four common diseases are valid and feasible for wheat diseases identification.

[4] KHIRADE S D, PATIL A B. Plant disease detection using image processing [C]// Proceedings of the 2015International Conference on Computing Communication Control and Automation. Piscataway: IEEE Computer Society, 2015: 768–771.

Detection of plant disease in an early stage is highly crucial. Disease symptoms are seen in different parts of a plant; however plant leaves are found to be the most commonly observed part of plant for detecting an infection. We have thus attempted to automate the procedure of plant disease detection identification. Faster the disease are identified , faster the measures can be taken. Several works utilized computer technologies and contributed a lot in this domain. A study on commonly studied infections and research scenario in different
Phases of a disease detection system are presented. . The dataset contains many images of leaves with their commonly observed diseases. We have used a CNN for automatic feature extraction and classification. Diseases are distinguishable on the basis of their appearance like size, shape, color etc. Identification these features as soon as possible are essential.

[5] JIA S P, GAO H J, HANG X. Advances in image recognition technology of crop diseases and insect pests based on deep learning [J]. Chinese journal of agricultural machinery, 2019, 50(S1):313-317.

In recent years, with the development of machine learning and deep learning, it is possible to identify and even control crop diseases by using electronic devices instead of manual observation. In this paper, an image recognition method of citrus diseases based on deep learning is proposed. We built a citrus image dataset including six common citrus diseases. The deep learning network is used to train and learn these images, which can effectively identify and classify crop diseases. In the experiment, we use MobileNetV2 model as the primary network and compare it with other network models in the aspect of speed, model size, accuracy. Results show that our method reduces the prediction time consumption and model size while keeping a good classification accuracy. Finally, we discuss the significance of using MobileNetV2 to identify and classify agricultural diseases in mobile terminal, and put forward relevant suggestions.

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[6] LIU Y Y,FENG Q,YANG S. Detecting grape diseases based on convolutional neural network [J].Journal of Northeast Agricultural University, 2018, 49(3) : 73 –83.

Anthracnose, brown spot, mites, black rot, downy mildew, and leaf blight are six common grape leaf pests and diseases, which cause severe economic losses to the grape industry. Timely diagnosis and accurate identification of grape leaf diseases are decisive for controlling the spread of disease and ensuring the healthy development of the grape industry. This paper proposes a novel recognition approach that is based on improved convolutional neural networks for the diagnoses of grape leaf diseases.

[7] RAMCHARAN A, BARANOWSKI K, MCCLOSKEY P, et al. Deep learning for image-based cassava disease detection [J]. Frontiers in Plant Science, 2017, 8:1852.

Convolutional neural network (CNN) models have the potential to improve plant disease phenol typing where the standard approach is visual diagnostics requiring specialized training. In scenarios where a CNN is deployed on mobile devices, models are presented with new challenges due to lighting and orientation. It is essential for model assessment to be conducted in real world conditions if such models are to be reliably integrated with computer vision products for plant disease phenotyping. We train a CNN object detection model to identify foliar symptoms of diseases in cassava (Manihot esculenta Crantz).

[8] Srdjan S, Marko A, Andras A, et al. Deep Neural Networks Based Recognition of Plant Diseases by Leaf Image Classification: [J]. Computational Intelligence and Neuroscience, 2016, (2016-6-22), 2016, 2016(6):1-11.

The latest generation of convolutional neural networks (CNNs) has achieved impressive results in the field of image classification. This paper is concerned with a new approach to the development of plant disease recognition model, based on leaf image classification, by the use of deep convolutional networks. Novel way of training and the methodology used facilitate a quick and easy system implementation in practice. The developed model is able to recognize 13 different types of plant diseases out of healthy leaves, with the ability to distinguish plant leaves from their surroundings. According to our knowledge, this method for plant disease recognition has been proposed for the first time. All essential steps required for implementing this disease recognition model are fully described throughout the paper, starting from gathering images in order to create a database, assessed by agricultural experts.

[9] Alarifi j. s. goyal m. davison a. k. dancey d. khan r. yap m. h. (2017, july). Facial skin classification using convolutional neural networks. in international conference image analysis and recognition . Springer. 10.1007/978-3-319-59876-5_53.

Facial skin assessment is crucial for a number of fields including the make-up industry, dermatology and plastic surgery. This paper addresses skin classification techniques which use conventional machine learning and state-of-the-art Convolutional Neural Networks to classify three types of facial skin patches, namely normal, spots and wrinkles. This study aims to accomplish the pivotal work on the basis of these three classes to provide the collective facial skin quality score. In this work, we collected high quality face images of people from different ethnicities to create a derma dataset.

[10] Amara j., bouaziz b. and algergawy a. 2017. a deep learning-based approach for banana leaf diseases classification. in btw (workshops).

Banana cultivation is one of the main agricultural elements in India, while the common problem of cultivation is that the crop has been influenced by several diseases, while the pest indications have been needed for discovering the infections initially for avoiding the financial loss to the farmers. This problem will affect the entire banana productivity and directly affects the economy of the country. A hybrid convolution neural network (CNN) enabled banana disease detection, and the classification is proposed to overcome these issues guide the farmers through enabling fertilizers that have to be utilized for avoiding the disease in the initial stages, and the proposed technique shows 99% of accuracy that is compared with the related deep learning techniques.

[11] Revathi P. and Hemalatha M. 2012, December. Classification of cotton leaf spot diseases using image processing edge detection techniques. In 2012 International Conference on Emerging Trends in Science, Engineering and Technology (INCOSET)

In India Cotton is considered as one of the most important cash crops, as most farmers cultivate cotton in large number. The diseases on cotton, over past few decades have to lead to tremendous loss of yield and productivity. Identification of cotton diseases at early stage diagnosis is important [1]. The goal of our proposed work presents a system using simple image processing approach for automatic diagnosis of cotton leaf diseases [2]. Classification based

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on selecting appropriate features such as color, texture of images done by using SVM classifier. The images are acquired from cotton fields using a digital camera. Various preprocessing techniques as filtering, background removal, and enhancement are done. Color-based segmentation is done to obtain the diseased segmented part from the cotton leaf. Segmented image is used for feature extraction. Index Terms-Diseased Cotton leaf, Image pre-processing, Color based segmentation, Gray Level Co-occurrences Matrix (GLCM), Support Vector Machine (SVM).

III. REVIEW FINDINGS

A traditional approach to identify diseases is done by visiting local clinics. All disease detection methods are based on image processing and classification algorithms. These methods have good identification effect, but they still have poor flexibility when the data set is very large. Experts classify the diseases with naked eyes in planting area; it can easily affected by environmental factors and human factors. It requires automatic monitoring and processing of diseases which cannot be achieved.

DRAWBACKS:

- The identification of disease of Tomato leaves is bit difficult as it has to be done manually in the laboratory.
- It is also time consuming process as well.
- For detection of disease we have to go to laboratory and has to be tested with naked eye.
- This may be less efficient sometimes. So, to overcome this problem we are using CNN algorithm to detect the leaf disease.

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