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REVIEW ON THE DETECTION OF LEAF DISEASE USING IMAGE PROCESSING TECHNIQUES IN PLANTS

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Abstract:

To achieve this goal, a survey on the detection of leaf disease using various image processing methods will be conducted as part of this investigation. Digital image processing is a technique that is fast, trustworthy, and accurate when it comes to the diagnosis of plant diseases. Additional algorithms for the diagnosis and classification of leaf diseases in a number of plant species are available, and they may be used in a variety of situations. Multiple authors in this paper explore a range of sickness identification methodologies, including clustering, colour base picture analysis, classifiers, and artificial neural networks for classification of illnesses, among others. In this paper, we focus primarily on the assessment of several leaf disease detection systems, but we also provide a comprehensive review of various image processing techniques in general. This research makes use of a variety of concepts, including leaf disease classification, SVM, segmentation, morphological processing, features extraction, neural networks, clustering, and fuzzy logic.

Introduction:

India is primarily an agricultural country, and agriculture provides a means of subsistence for the vast majority of the population. When it comes to fruit and vegetable crops, farmers have a wide range of possibilities to choose from. With the use of technology, it is possible to increase the efficiency of the agricultural process. If a pathogen is present, any environmental condition might cause disease to develop in a plant. Most plant diseases exhibit themselves on the leaves, fruits, and stems of the plant, and as a consequence, early detection of illness is essential to the success of crop production. For the most part, pathogens, germs, fungi, bacteria, viruses, and other pathogens are to blame for the formation of plant illnesses in the first place. An unfavourable environment, which might include soil and water in some cases, can lead to the development of plant diseases in certain cases. When it comes to diagnosing the many different types of plant diseases in their early stages, there are a range of options. Naked eye observation techniques are the conventional method of detecting plant diseases; however, these approaches are inadequate when dealing with large fields of crops. When digital image processing methods are used in the detection of plant diseases, the procedure is more efficient, less time-consuming, and the results are more accurate. By removing the need for pesticides, this technique saves time, effort, labour, and money. It also reduces the use of pesticides. Different authors propose a range of ways for accurate plant disease diagnosis using digital image processing, each with its own set of benefits and drawbacks, which are discussed in detail below. A great number of algorithms have been developed by a range of academics for the purpose of image processing. This paper provides an overview of many different types of image processing algorithms for the detection and classification of various leaf diseases, as well as their applications in the field of agriculture. Leaf disease identification is introduced in the first part, which offers an overview of the process. A concise assessment of the literature is provided in Section 2, and it includes all of the tactics used by all of the authors. Part III of this section is a review table that allows you to quickly find out about the methodologies that were used by all of the authors for the different research. The results of the article are presented in Section 4 of this publication.

2. LITERATURE REVIEW

Rice disease detection approach presented in article [1] was used to the two most frequent diseases in north-eastern India, namely Leaf Blast (MagnaportheGrisea) and Brown Spot (Secalaria sativa) (CochiobolusMiyabeanus). Images are acquired as a starting point, and from there, the author uses methods such as segmentation, boundary detection, and spot detection to extract features from diseased portions of the leaf. A zooming approach is introduced in this study, in which a SOM (Self Organising Map) neural network is employed for the categorization of damaged rice photos, according to the author. In SOM, there are two approaches for creating an input vector. The first approach is the padding of zeros, while the second method is the interpolation of missing points. The first method is the padding of zeros. The interpolation approach is used for fractional zooming in order to equalise the size of the spots once they have been normalised. Improved categorization is not achieved by transforming images into the frequency domain (see figure). A total of four distinct kinds of photos are used for testing reasons; the zooming method produces good categorization results for the test images when used correctly. The authors of article [2] describe an image-processing approach for the diagnosis of leaf and stem disease. The author made use of a collection of leaf photographs taken in Jordan's Al-Ghor region. In this experiment, the image processing approach is used to test for five plant diseases: early scorch, ashen mould (late scorch), cottony mould (early scorch), and little whiteness (early whiteness). The K-Means clustering approach is utilised for segmentation in this methodology, which begins with picture capture and is followed by segmentation. In the next step, CCM (Colour Co-occurrence Method) is employed for texture analysis of the diseased leaf and stem, which is then used in feature extraction. Finally, this research proposes a back propagation strategy for neural networks that is used in the categorization of plant disease. Using this image processing technology, effective identification and categorization of plant diseases may be achieved with a high degree of accuracy (about 93 percent). When it came to image processing, the authors of study [3] employed both LABVIEW and MATLAB software in order to identify chilli plant illness. Using a combination of techniques, this approach identifies illness at an early stage via leaf examination. The image was obtained with the help of LABVIEW. Further analysis is carried out using IMAQ Vision and MATLAB.

The processes for image processing are detailed in further detail below. Images may be pre-processed using methods such as Fourier filtering, edge detection, and morphological processes, to name a few. Color clustering is used to distinguish between chilli and non-chili leaves in feature extractions, allowing the two kinds of leaves to be distinguished from one another. Following that, the healthiness of each chilli plant in question is assessed using image recognition and classification techniques. With this strategy, the use of hazardous chemicals in the chilli plant is reduced, resulting in a decrease in the cost of production while maintaining the excellent quality of the chilli. According to the authors of the research [4, image processing methods are used to illustrate how to diagnose MalusDomestica leaf disease]. It is necessary to utilise the histogram equalisation technique when dealing with grayscale pictures in order to get the intensity values. Image segmentation is accomplished by the use of the Co-occurrence matrix method approach for texture analysis and the K-means clustering algorithm for colour analysis, both of which are detailed in further detail further down this page. In photography, texture analysis is the process of categorising parts of a photograph depending on the amount of texture present in them. In colour analysis, the aim is to lower the sum of squares between objects and the centroid or matching cluster of their respective classes, a process known as subtraction. Individual pixels' values are compared to the value of the threshold during the threshold matching operation, and if their values are greater than the threshold, the pixel is labelled as an object pixel.

Texture and colour analysis shots are compared to past photographs taken with the same source of light in order to diagnose plant ailments. In the future, the author intends to use Bayes and K-means clustering approaches to further his research. Image processing techniques for recognising Bacterial infection in plant tissues are described by the authors of a recent study [5]. Botanical leaf scorch (bacterial leaf scorch) is a frequent disease that damages plants, and early detection of this infection may help to improve the general growth of the plant. The image processing process starts with image acquisition, which includes basic procedures such as the capturing of a picture and its translation to a computer-readable format. Image acquisition is the first step in the image processing process. The acquisition of images is the initial stage in the image processing process. Afterwards, using the K-means clustering technique for photo segmentation, it is feasible to discriminate between the foreground and background pictures in a picture. When using intensity mapping, the clustering procedure is carried out, and the highlighting of leaf area is performed by subtracting the clustered leaf photos from the original base images. When compared to fuzzy logic, the

K-means clustering approach is more simple and successful in finding contaminated regions, while needing less human cluster selection in comparison to the fuzzy logic technique. With the use of ADSP target boards and FPGA tools, it is possible to make modifications to the implementation. The effort of many scientists [6] has included the development of an image processing approach for identifying ill areas of citrus leaves. Citrus infections may be split into four categories: citrus canker, anthracnose, overwatering, and citrus greening. Citrus canker is the most common kind of citrus sickness. Overwatering and anthracnose are the most prevalent types of disease in citrus trees, with citrus canker being the most common kind. The author devised a method in which picture acquisition is the first step, with photos recorded by a digital camera in high resolution and then put into a database as the second step. Color space conversion and picture enhancement are carried out at the pre-processing step of the image creation process. Enhancement of colour pictures is performed by the use of the discrete cosine transform domain. When converting between colour spaces, the YCbCr colour system and the L*a*b* colour space are used as reference points, respectively. According to the author, the Gray-Level Co-Occurrence Matrix (GLCM) and the graycoprops function are used to offer a statistical approach for feature extraction that analyses statistics such as contrast and energy as well as homogeneity and entropy in images.

When it comes to differentiating citrus leaf diseases, there are two types of support vector machine (SVM) classifiers that may be used: the SVMRBF classifier and the SVMPOLY classifier. The authors of article [7] discuss an image processing strategy for the diagnosis of Orchid leaf disease that they developed themselves. Infections of the leaves of orchids, such as black leaf spot and sun burn, are the most prevalent types of orchid leaf diseases. First, image acquisition must be completed before any image processing can begin. This entails taking photos and saving them on your computer so that you may utilise them later. Picture pre-processing encompasses techniques such as histogram equalisation, intensity correction, and filtering, all of which are used to improve or modify a picture in various ways. The boundary segmentation technique makes use of three morphological processes in order to exclude small things from the image while retaining large objects in the image. Thresholding is a technique used in segmentation to establish the starting and ending points of a line so that edges may be drawn between them. Added by the author, the ROI (region of interest) has been included in the GUI. Following the boundary segmentation technique, a classification is carried out by counting the amount of white pixels present in the image and classifying them accordingly. This method produces outcomes with a high degree of precision and a low percentage of inaccuracies in comparison to other systems. The authors of article [8] provide a method for identifying infections in tomato leaves that uses image processing techniques. During the image collecting phase, digital images of sick tomato leaves are obtained, which include two types of tomato diseases, namely early blight and powdery mildew. These digital photographs of diseased tomato leaves are used to acquire information on the illnesses. This stage comprises the use of numerous techniques for image enhancement, smoothness, noise reduction (including scaling pictures), isolation of images, and background removal, among other things (amongst other things). It is the author's intention in this research to present the Gabor wavelet transformation as well as the Support vector machine for the diagnosis and categorization of tomato disorders. By using the Gabor wavelet transform in the feature extraction stage, it is possible to generate feature vectors that will be utilised in the ensuing classification phase.

Once we reach the classification stage, we train a support vector machine (SVM) to recognise the many kinds of tomato diseases. While the SVM accepts as inputs feature vectors and associated classifications, it provides as outputs a decision on whether or not to diagnose tomato plant leaf disease, which is based on the inputs. The SVM is implemented via the usage of the Invmult Kernel, Cauchy Kernel, and Laplacian Kernel functions, which are all derived from the Invmult Kernel. Performance evaluation is carried out utilising grid search and N-fold cross-validation processes, as well as other techniques. In their study [9], the researchers discussed illness detection, where image processing is the first stage in acquiring an image in digital form and pre-processing is the second stage in removing noise and other objects from the image. Image processing is the first stage in acquiring an image in digital form, and pre-processing is the second stage in removing noise and other objects from the image. In addition to the other processes, pre-processing turns RGB photographs into greyscale images using the equation $f(x) = 0.2989*R + 0.5870*G + 0.114*B$ and conducts histogram equalisation, among other things. In order to pinpoint the afflicted region of the leaf, image segmentation is performed using boundary and spot detection methods, as well as other techniques. A method known as K-means clustering is used to categorise the things in a given collection of items. Thresholding is performed by the use of the Otsu threshold method, which generates binary images from greyscale photos. The use of feature extraction, which includes colour, texture, morphology, and edges, to detect plant illnesses makes it feasible to detect disease in plants. In image processing, feature extraction approaches such as leaf colour extraction using the H and B components and the colour co-occurrence approach are used to extract information on the colour of the leaf from the picture data. For the classification of illnesses and the provision of suggestions, artificial neural networks (ANNs) and back propagation networks (BPNs) are utilised.

They demonstrate how to identify Scorch and Spot plant diseases using an image processing approach, according to the research's authors [10]. The first step is to take a photograph of the plant in all of its many shades (RGB). When the preliminary processing is completed, a colour transformation structure is created, and colour data in the RGB format is transformed into a spatial format. Using K-means clustering, it is required to conceal green pixels after they have been grouped together in a single group. Isolated cells that are located inside the limits of infected clusters are removed from the image as a result of this. It is necessary to segment an image in order to isolate and save just the information that is helpful to you. It is necessary to apply the colour co-occurrence approach in order to extract features from a picture since it computes the image's colour and texture characteristics, as well as its edge attributes. Because of the way neural networks are configured, they are capable of both recognising and diagnosing disorders. The investigation of disease conditions in citrus trees that have been grown in an outdoor setting will be a focus of future study. The authors of article [11] provide a method for recognising groundnut plant disease that makes use of image processing methods to identify the illness. The groundnut plant is primarily affected by two diseases: early leaf spot (Cercospora) and late leaf spot (Cercospora). Early leaf spot (Cercospora) is the more serious of the two illnesses (Cercosporidiumpersonatum). Photographs of leaves are taken in RGB format and then converted to HSV colour photos after they have been transformed to HSV colour photographs. Identifying the presence of green-colored pixels in a photograph is critical for reducing the amount of time spent processing the photograph. Color and texture feature extraction are both investigated using the co-occurrence matrices approach, which is a kind of statistical analysis. When it comes to extracting texture features from texture pictures, there are two approaches that may be employed. The first is to use a texture image as a source for the texture features to be extracted. This is referred to as the structured approach in the first technique, while it is referred to as the statistical approach in the second technique. In this research, the author used a statistical methodology. The back propagation strategy is used in the classification and detection of groundnut illnesses, and it is very effective. Back propagation phases may be classified into two groups, which are as follows: phase 1 and phase 2. The first is known as propagation, while the second is known as weight modification. According to their results, the authors were successful in appropriately categorising four distinct illnesses with 97 percent accuracy. In their publication [12], they present a plant disease detection approach in which the first stage is to develop a colour transformation structure for an RGB leaf image, and the second step is to convert the RGB leaf image's colour values to a space described by the colour transformation structure. Following the translation of the picture into a new colour space, the K-means approach is used to split the image into different portions that can be distinguished. Green pixel masking, also known as masking of green pixels, is the second step in the process of removing unnecessary components of the image from the final image, such as green patches within leaf sections. As part of the third phase of their assignment, after finishing texture feature calculations on segmented infected objects, the authors perform an additional deletion of masked cells inside the edges of infected clusters that were previously masked. Infected cluster pictures are transformed to HSI photographs, and an SGDM matrix for the H and S channels is constructed from RGB images. In the fourth phase, it is necessary to compute texture statistics and features, which is accomplished via the use of the GLCM function, which is detailed in further detail later in this section. Once this has been accomplished, the information is sent into a neural network that has been pre-trained to recognise diseases and categorise them based on their characteristics. An image processing technique for detecting illness in sugarcane leaves was described in detail in [13], which was developed by the authors of the publication [13]. Brown Spot, Downy mildew, Sugarcane mosaic, Red stripe, Red rot, and Downy fungal were among the diseases used by the authors in their experiment.

Brown Spot was one of six diseases used in the experiment. TIF, PNG, JPEG, and BMP image formats are often used for picture acquisition and processing. Photographs acquired for image analysis are collected at higher quality resolutions and in image formats that are more suitable for image analysis. During the pre-processing stage, a grayscale conversion of RGB photos is conducted, and any unnecessary data from the photographs is eliminated from the images. If a picture contains green pixels and is in good health, the segment of the picture is differentiated from the possibly unhealthy portion of the same picture, which is in bad health. SVM (linear SVM), nonlinear SVM (nonlinear SVM), and multiclass SVM (multiclass SVM) are the three algorithms that are employed in feature extraction for illness diagnosis, respectively. The linear SVM algorithm is the most often used approach. The linear SVM approach is the most often utilised of the SVM methodologies.

Paper	Techniques Used
[1] Rice Disease identification using Pattern Recognition Techniques	Zooming algorithm, SOM neural network
[2] A Framework for Detection and Classification of Plant Leaf and Stem Diseases	K-Means clustering, Back propagation algorithm, CCM
[3] Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques	Morphological processing, Color clustering, LABVIEW IMAQ Vision
[4] Remote Area Plant Disease Detection Using Image Processing	CCM, K-Means clustering
[5] A Novel Algorithm for Detecting Bacterial Leaf Scorch (BLS) of Shade Trees Using Image Processing	K-means clustering algorithm, Intensity mapping
[6] Unhealthy Region of Citrus Leaf Detection Using Image Processing Techniques	GLCM, SF-CES, SVMRBF & SVMPOLY classifier
[7] Orchid Leaf Disease Detection using Border Segmentation Techniques	Border segmentation, Pattern classification

4. CONCLUSIONS

Using image processing techniques, this study aims to offer an overview of leaf disease detection and classification algorithms that may be used in the field of plant pathology. Various writers used a variety of strategies that were all distinct from one another in order to accurately diagnose illnesses and treat them. Image processing systems have the benefit of allowing for the detection of leaf diseases at an early stage, which is useful. Most research employed artificial neural networks and classifiers such as artificial neural networks, support vector machines, and other related technologies to improve recognition rates. All of the tactics presented in this research are time-saving and provide good outcomes, which makes them very appealing.

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