An Efficient Technique For Predicting Plant Leaf Diseases In Digital Image Processing

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Abstract: The digital image processing techniques has been widely used in various applications. One of the application is agriculture. In agriculture plant disease detection and diagnosis using digital image processing techniques focused on accurate segmentation of healthy and diseased tissue. In various segmentation methods, Semi-automatic segmentation was most widely utilized which was based on gray scale histogram. In a novel semi-automatic segmentation process, pixels along the edges were removed and then color conversion was done. After color conversion, contrast enhancement of an image and pixel value adjustments were performed to improve the image quality. Histogram with 100 bins was constructed for identifying the diseased tissue from the healthier part of a leaf image. Finally, segmentation of diseased leaf was found based on the histogram bins. Such bins were searched manually which is not easy for all cases. Moreover, detection accuracy was degraded by the influence of reflection light and distortion regions in an acquired image. Hence Quality Assessment Method Scheme (QAMS) algorithm used to remove both reflection light and distortion from image. For automatic separation of diseased part from the healthier regions in a leaf image an optimization algorithm is required. The method employs Convolutional Neural Networks (CNN) algorithm to automatically define the histogram bins and separate diseased part from the healthier regions in a leaf image. After segmenting the diseased leaf image, the classification is done by Support Vector Machine (SVM) to detect the leaf diseases. The method provides better detection accuracy and computational time is reduced.

Keywords— CNN, Diseases detection, Distortion removal, Reflection light, SVM.

1. Introduction

Agriculture is the primary backbone of Indian economy. Image processing has wide range of applications in the agricultural field for the following purposes, prediction of plant disease from plant image and prediction of pest attacks from plant image.

In Plants, diseases are mainly occurred due to the impairment of normal physiological function of plants which produce characteristic symptoms. Diseases are mainly caused by pathogens. These pathogens are found on the leaves or stems of the plant. At this instance, image processing plays a vital role in detecting the diseases in plants.

Digital image processing based techniques provides accurate segmentation on segmenting diseased and healthy tissue. There are different methods developed for detecting plant disease such as thresholding, region growing, clustering, and Edge based detection. For detection process, the image should undergo some process like pre-processing, segmentation, feature extraction and classification processes.

Pre-processing is the step used to remove unnecessary features from an image. In segmentation, the image is segmented to useful regions. Then from the segmented image, features such as grey level, color, texture, shape, depth, motion are extracted. Based on the selected features, classifiers in classification process classify the given input data into number of classes and groups.

For segmentation of disease symptoms, color space should be appropriately chosen. There are various color spaces used for image analysis. But most of the methods use Hue-Saturation-Value (HSV) or L*a*b* (Lightness and two channels representing opposing color dimensions) color channels. After the color space conversion, only one channel from both color spaces is used for segmentation. After channel selection, segmentation is then proceeds by employing segmentation methods. Based on the threshold values, the healthy and diseased tissue is identified.

1.1 Plant leaf diseases

In agriculture the Plant leaf diseases identification has a wide application, and is especially significant to the biology diversity research. Classifying plant leaf finds application in botany and other industries. Environmental protection is important for plants. Shape is one of the
most important features for characterizing various plants leaves visually. Plant leaves have two-shapes in nature and thus they are most suitable for machine processing. The paper presents survey of different leaf diseases identification. The diseases of plant leaf in two forms of the diseases can be, Infectious diseases such as Fungi, Bacteria, Viruses, etc and Non-infectious diseases such as Mineral toxicities, soil acidity, nutrient deficiencies, or environmental factors.

1.2 Fungal disease symptoms

The fungal disease areas covered with white to greyish are (a) Late blight, (b)Early blight, (c)Downy mildew. In late blight, it appears on lower, older leaves water-soaked, gray green spots. The fungal disease occurs, these spots darken and then white fungal growth forms on the undersides.

Early blight is caused by the fungus Alternariasolani. The small brown spots with concentric rings that form a bulls eye pattern appears on the older and lower leaves. It spreads outward on the leaf surface causing it to turn yellow when diseases occurred. In downy mildew yellow to white patches on the upper surfaces of older leaves occurred.

1.3 Bacterial disease symptoms

The bacterial disease is separated by tiny pale green spots which can be viewed as water-soaked. Then dry dead spots is appeared in leaves e.g. brown or black water-soaked spots on the foliage is bacterial leaf spot, it may be with a yellow halo, commonly it is identical in size. The spots have a speckle appearance under dry conditions.

1.4 Viral disease symptoms

Virus disease in plant produce no telltale signs that can be visually identified and easily confused with nutrient deficiencies and herbicide injury. Viruses are the most difficult to diagnose. Mosaic Virus in plant like yellow or green stripes or spots on greenish. Leaves might be wrinkled, curled and growth may be stunted.

1.5 Histogram

A histogram is a pictorial representation of the distribution of numerical data. It is continuous variable of the probability distribution (quantitative variable)."bin" the range of values— is first step to construct histogram that is, the entire range of values is divide into a series of intervals—and then count how many values fall into each interval. The bins are specified as continuous, does not overlap intervals of a variable. The intervals must be close, and bins (but are not required to be) of equal size.

2. Related works

Reflection and distortion separation in photography is difficult. The issue of this reflection and distortion separation arises naturally in our everyday life when a desired action contains another actions reflected off a transparent or semi reflective medium. Common examples for this is when we see picture through windows or taking the picture of an object which are placed inside a glass. Reflection occurred in such kind of images. Sometimes the camera may be shake when we take photographs so the image will be distorted or blurred. Distortion will occur either the properties of the camera lens or position relative to the subject. One type of distortion is caused when the camera is keen at an extreme angle to the subject. The problem of removing reflection and distortion from un-natural images[5]. This will effected in the quality of images. Reflection happens when there is the change in direction of a
wave front at an interface between two different media are glass and water so that the wave front returns into the medium from which it originated. The law of reflection describes for specular reflection is mirror like reflection of light from a surface.

A picture made using a camera distortion will happens when either the properties of the camera lens or the position . Here the input contains multiple polarized images with different polarizer angles[1]. The output consists of high quality image which is removed distortion and reflection separation method. In this paper proposed a Quality Assessment method Scheme (QAMS) for removing image reflection and distortion. Using this QAMS method, the image quality can be increased by measuring PSNR and Error Rate. Distortion will occurred when either the properties of the camera lens or the position relative to the subject. One type of distortion is caused by the camera is keen at an extreme angle to the subject. Another type of distortion inside a lens there is a round glass element, with the side effect of this type of glasses occurs barrel distortion. Due to the effect of bending light more near to the edges of the lens then it is near the center of the lens. When the lens diameter is smaller it will get more extreme effect of barrel Distortion. The image with reflection can be described by a linear superposition of two forms: the background layer from the action beyond the glass and the reflection layer from the action reflected by the glass.

3. Existing system

In the earlier work first the images were collected from the datasets. Erosion was applied to remove the pixels present in the leaves edges. Conventional image was then transformed into HSV and L*a*b* color spaces. The existing system considered H and a channels from both color spaces. Brightest pixels in H channels were then corrected. After the correction of brightest pixel, the contrast of the grayscale images was enhanced by using original and new values of the pixels. Histogram of both H and a channel was constructed using 100-bin histogram.

The pixel value to separate healthy and diseased tissue should be found for segmentation using histogram bins. Then the bins are found by manual identification. When the global maximum is located in lower value bins, it indicates that the leaf is severely diseased. On the other hand, if the global maximum is located in higher value bins, this indicates that the leaf is still relatively healthy, with green dominating the histogram. Finally, user selects images (that obtained for channel H or a, respectively) that provides the most accurate segmentation.

4. Proposed work

To detect and classify the plant leaf diseases first the images were collected from the datasets. The pixels that are located along the edges of the leaves are removed by performing erosion using a 5-pixel diameter disk as the structuring element. Reflection happens when there is the variation in direction of a wave front at action between two different media so that the wave front returns into the medium from which it originated. Distortion will happens when either the properties of the lens or the position of the camera relative to the subject. Reflection light and distortion on images is removed by using Quality Assessment method Scheme (QAMS). Reflection and distortion light in the image removes it using reflection separation and distortion separation algorithm. Conventional image was then transformed into HSV and L*a*b* color spaces. The system considered H and a channels from both color spaces. Brightest pixels in channels were then corrected.

After brightest pixel correction, contrast enhancement of the image were performed to improve the image quality. In existing system histogram of both H and a channels was constructed using 100-bin histogram[1]. The pixel value to separate healthy and diseased tissue should be found for segmentation using histogram bins. The identification of bin is used to represent values of green (healthy) pixels in each image, considering that green tissue tends to be represented as a light shade of gray in the grayscale images. Instead of manual identification of histogram bins, Convolutional Neural Networks (CNNs) is used. It is a feed-forward artificial neural network and it is based on biological processes. This network estimate features from input images. CNN is trained to learn features for large amount of datasets with classification function focused to reduce error. After the application of CNN, diseased regions are automatically segmented from the normal regions. Then best segmentation image is chosen from either of the channels. SVM classifier is used to detect diseases in image.

Algorithm 1: Reflection separation

Input: Image 1 to Image N
Output: reflection removed image

Construct the Gaussian image pyramid.
For each level, from coarse to fine, in the multi-scale pyramid.
Compute the mask image and the reflection guide map.
If the current scale is the coarsest scale,
Initialize \( a_i \)
else:
Up-sample the results of \( a_i \), R and B.
Evaluate the regularization weights $\lambda_{a_1}$, $\lambda_R$ and $\lambda_B$.

For a fixed number of iterations do:
Estimate $(R, B)$ with $\alpha_i$ fixed.
Estimate $\alpha_i$ with $(R, B)$ fixed.
end for
end for

Construct the Gaussian image Pyramid

While(step>minstep)
\{ Calculate_error_at (K-step)
Calculate_error_at (K+step)
Calculate_error_at (K)
If(K is smallest)
Step:=step/4;
else
If(K-step was better)
k:=K-step
else
K:=K+step

Constructing Gaussian image pyramid. Then algorithm for distortion tries to calculate two main parameters of the distortion $K_1$ and $K_2$. It is based on an extremely simple search loop finding one parameter(k) at a time is either k1 or k2.

5. Edge removal

Edge detection and edge removal are the two primary steps in image processing. In this module, the pixels that are located along the edges of the leaves are removed by performing erosion using a 5-pixel diameter disk as the structuring element. The main purpose of removing these pixels is to avoid some inconsistencies that are occurred during image analysis. This edge removal process can cause little impact on the detection accuracy of the final results because, some negligible amount of pixels with diseased symptoms are removed.

6. Reflection light removal using QAMS

Reflection separation is done by using the effect of reflection under different rotation angles of a polarizer. Each input image is down-sampled for constructing Gaussian image pyramid. For each scale, the mask image and reflection guide map are constructed and non-convex energy function is reduced by solving reflection and background layer problems. For each level, QAMS starts at the coarsest scale and goes down scale by scale toward the finest scale of the pyramid. Then if the current scale of the image is coarsest scale, amount of
reflection remaining in the image is initialized and they are up-sampled along with values of reflection and background of the image. Regularization weights of obtained values are calculated. This will proceed for each level. Then obtained refined values are updated in reflection guide map.

7. Distortion removal using QAMS

Distortion is mainly resulted by the lens properties and position of the camera relative to the subject. If the camera is placed at the extreme angle to the subject, then distortion occurs. Other form of distortion is barrel Distortion. A round glass element that is present inside the lens causes this type of barrel Distortion. Initially, reflection light removed image is checked for distortion. If there is any distortion part detected, then use distortion separation algorithm and remove the distorted region. In Distortion algorithm, Parameters such as K1 and K2 that are based on search loop finding one parameter (k) are calculated.

8. Color space conversion

In general, Color Space Conversion coverts one basic form of color representation into another form. In this module, Red-Green-Blue (RGB) color space is transformed into two different transformations. One is Hue-Saturation-Value (HSV) color space and another one is Lightness and two channels (a and b) (L*a*b) color space transformation. From HSV and L*a*b color spaces, channel H from HSV and channel a from L*a*b are only considered for further process. After the transformation, 8-bit image format (pixel values varies from 0 to 255) is changed into 16-bit double format with pixel values ranges from 0 to 1.

9. Conclusion

The Reflection light and distortion on images is removed by using Quality Assessment method Scheme (QAMS). In existing system, the specular light is used and the histogram bins is manually identified. The edge removal and reflection lights and distortion is removed using quality assessment method scheme is done .Then, the image is converted to color channels and pixel correction is applied. In future direction, the contrast enhancement is used the histogram bin is identified automatically by using CNN. After the application of CNN, diseased regions are automatically segmented from the normal regions. Then, the best segmentation image is chosen from either of the channels. A classification support vector machine (SVM) is used detect the disease in plant leaf image. The proposed system provides accurate segmentation of diseased leaves and it provides detection accuracy . The computation time will be reduced because of automatic identification of bins in histogram.

10. References


