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Super-Pixel Segmentation and Saliency based Plant Leaf Disease Detection using SVM

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Abstract: The highest source of income received by India is only through the agriculture. Therefore, it is mentioned as Indian economy is mostly dependent on the outputs of the farming or the agriculture. This is the reason why detection of diseases present in the plants plays a precious role in the field of the farming. If the care is not taken perfectly to the plants, then it creates a highest loss on farming by which the economy of the India gets decreased. Hence for effective identity of diseases now-a-days developers are producing few of the automatic methods or ideas which are profitable for farmers and farming through which monitoring in the lengthened farms becomes very easier. It happens because of the advanced technology utilized, this technology identifies the diseases in the earlier stage only, even capable of identifying the type of disease occurred to that particular filed. An algorithm is mentioned in this paper which is for the technique of image segmentation, which is being utilized for automatic detection of the diseases occurred on leafs of the plants. Image segmentation plays a key role for detecting the diseases in the leaf of the plants. This can be achieved by utilizing an algorithm known as genetic algorithm. This paper gives an explanation about this genetic algorithm.

Index Terms: Image segmentation, Matlab, USB Cemera, genetic algorithm.

I. INTRODUCTION

Now-a-days agriculture has become highly easier as compared with the olden days, this is only the means of the country through which entire country can have food even in the conditions of the growing population. Plants play a key role for energy, and are a basic concept in the puzzle to resolve the issues of the global warming. There are various diseases which damage the survival of the plants with the potential to cause destruction economically, socially and ecologically. This project mainly concentrates on identifying the diseases in a perfect and timely way.

There are various methods for identifying the pathologies of the plants. There are some of the diseases which cannot be observed by the human naked eye, it will not show any symptoms, but it damages the entire plant. Under these situations, generally few types of sophisticated analysis are utilized, which needs powerful microscopes. In other conditions, the signs will be identified in portions of the electromagnetic spectrum which can be visualized through the human naked eye. The general strategy in this condition is the utilization of the remote sensing methods which examine the multi and hyper spectral captures of the image. The techniques which utilize this strategy often utilize the digital image processing tools for achieving their targets. The current utilizing methods for plant disease identification are easily naked eye observation by experts by which one can identify and detect the disease of the plant. For achieving this, one should need the large team of experts and also the continuous guiding of experts; this needs a lot of cost when we are having the larger farms. Similarly, in few of the countries, even there are no proper facilities for the cultivators they can approach directly to such teams. Due to which consulting experts even cost high as well as time consuming too. Under such situations the technique suggested gives beneficial profits in guiding the larger fields of crops. The diseases can be identified very easily by using the symptoms present on the leaves of the plants which make them very easier and cheaper also. It also supports the vision of machine to give perfect image on the basis of automatic process control, inspection, and robot guidance [2] [4] [5]. The visual way of identifying the plant disease is highly the laborious task and at the similar time it is less accurate and can be achieved only in the limited areas. Whereas if automatic detection technique is utilizedas it needs less efforts, less time and more accurately. In plants, some general diseases are brown and yellow spots, or early and late scorch, and the remaining are fungal, viral and bacterial diseases. Image processing is the method which is utilized for calculating the area affected of the disease, and to identify the variation in the color of the area affected [1][2][6].

II. PROCEDURE

A. Literature procedure

Due to the information collected by utilizing the image processing methods will not only identify the diseases but also estimates its severity also, this is not achieved in many of the techniques which were utilized previously. The two major situations where the simple detection applies are:

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Fig 1. Cabbage leaf disease detection

Partial classification: if the disease should be determined among the various possible pathologies, then partial classification gives an efficient outcome, here the classification will be done in the candidate's regions as because the result of the disease of interest or not, rather than utilizing the entire classification into any of the possible diseases. This technique is brought into existence by Abdullah et al. (2007). The explanation about this will be given clearly in the portion of Neural networks in this paper.

Real time monitoring: this technique will be utilized if the system has to monitor the crops without any pause, and if the disease gets identified from any plant then it gives an alarm and intimates immediately. This was come into existence by Sena Je et al (2003) and story et al (2010).

B. Neural networks

The technique projected by Abdullah et all (2007), is capable of discriminating the specified disease from the remaining pathologies which affect the leaves of the rubber tree. Segmentation will not be observed in this algorithm. An analysis is applied to this technique for getting the efficient results. The name of the analysis is Principal Component Segmentation analysis. This analysis is directly applied to the pixel values of the RGB of low resolution images of the leaves (15 X 15 pixels). There are two principle components here. Those components are then fed to a Multilayer Perceptron MLP neural network with a hidden layer, whose outcome mentions the disease of the sample is infected.

The main aim of the technique which was proposed by Sena Jr et al, (2003) is to discriminate between maize plants damaged by fall armyworm from healthy ones utilizing the digital images. The algorithm was basically categorized into two main stages: image processing and image analysis. In the stage of the image processing, the image is transformed into a grey scale, thresholded and filtered to eliminate the false artifacts. The entire image is partitioned into 12 blocks in the stage of image analysis. The blocks where the area of the leafs are less than 5% of the entire area gets eliminated. For every remaining block, the number of objects connected, diseased regions which are represented are taken into consideration. If the number is more than the threshold value that means the value more than the empirical evaluation, then its value is set to ten, then this plant is considered as diseased.

C. Dual-segmented regression analysis:

The story et al. derived a method for guiding and detecting the deficiency of the calcium in lettuce. The first step is the segmentation of the plant by thresholding, so the canopy area is confined. The region of interest's outlines are applied again to the original image, where the area of interest is only taken into consideration. From that original image again the colored and texture features are drawn out. After this process, the onset of stress is identified through the separation point because of the calculation of the calcium deficiency by determining the mean difference among the containers of the treatment and control at every measured time for entire features. Dual-segmented regression analysis is done for determining where in time a variation point was presented among the nutrient-deficit group of plants and the healthy group of plants. The writers mentioned that their proposed systems can be utilized to guide the plants in greenhouse even in the night time, but more analysis is required for its usage during the day, when lighting conditions modify more intensely.

III. ALGORITHM

SLIC Algorithm:

The algorithm was started by sampling K regularly spaced clustering centers and affecting them to seed the locations corresponding to the shortest position of the gradient in the 3 X 3 neighborhood. This has to be done for the purpose of lessening the noisy pixel choices and positions of the lowest gradients at an edge. The gradients of an image can be calculated by utilizing the equation mentioned below:

$$G\,(x,y) = \|I(x+1,y) - I(x-1,y)\|^2 + \|I(x,y+1) - I(x,y-1)\|^2$$

Here $I(x,y)$ is taken for mentioning the lab vector corresponding to the pixel at positions of the x and y, and the modulus form or the L_2 form is represented as $\|.\|$. In this the information about the color and intensity is taken into consideration. Every pixel present in the image is linked with the closest cluster centre whose inspection area will overlap the pixel. When all the pixels are connected with the closest cluster Centre, a new Centre is calculated as the average lab x,y vector of the complete pixels relating to the cluster. Then repeat the process continuously for linking the pixels with the nearby cluster center and recalculate the cssluster centre until convergence. During the final stage of this process, some of the labels get remained, i.e.

some of the pixels in the neighborhood of the larger segmentations consisting of the similar label but not linked to it. While it is somewhat infrequent, this may occur against the spatial proximity measure as the proposed clustering method will not exceptionally enforce the connectivity.
Regardless, they enforce the connectivity in the final process of the algorithm by relabeling the disjoint segments by the labels of the heaviest by stander cluster. This procedure is O(N) complex and needs very less time as compared to the entire time needed for the image segmentation. The time taken by it is 10% of its entire time.

Algorithm

1. The cluster centers are initialized by sampling the
2. pixels at formal grid steps. Cluster centers are taken as $C_k = \{l_k, a_k, b_k, x_k, y_k\}^T$.
3. The cluster centers are perturbed in an n X n neighborhood, to the position of the lesser gradient.
4. Repeat the complete process
5. For every cluster center C_k do
6. Allocate the efficient matching pixels from a 2S X 2S square bystander over the cluster center with respect to distance measure Eq 1.
7. End for

8. Calculate the new cluster centers and residual error E {*L1 distance among previous centers and recalculate the centers*}

9. Until E $\leq$ threshold
10. Enforce the connectivity

Saliency Detection:

The wavelets are initially popularized in the 20th century by Alfred Haar, the growth of this area was highly increased since the late 20th century [18]. Currently, the utility of wavelets in signal analysis has been the content of the frequency for every level of disintegration. Most of the engineering applications are enhanced recently. Some of them are de-noising, compression, enhancement, vedio coding, and pattern classification, etc.

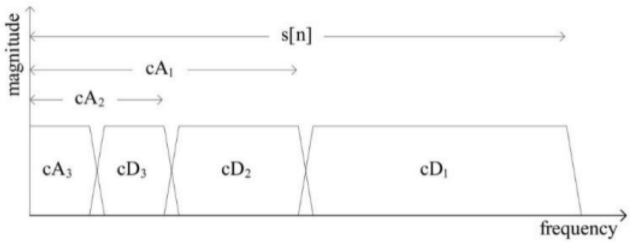

Fig 2. Magnitude Vs Frequency response

The analysis of the signal is which is done for frequency components can be attained by Fourier transform in a global context, but it is not that much possible for making the time-frequency analysis with FT cannot be achieved the STFT is utilized for performing the analysis of the local frequency, as it yields to the frequency information of a given time hence it is named as the time-frequency analysis that means the frequency analysis takes place with respect to time. The STFT will not utilize the time interval and in place of it it utilizes the spatial interval while handling with the image, as because the information about the time is not observed for images. Anyhow, this method will consist of few limitations. The constant resolution is not observed here, hence the success or failure of the application will depend on the choice of the spatial interval. Along with this because of the modifications in its spatial interval it increases the computation time of the application.

The multi-case wavelet examination and determination is capable of working effectively as compared with the local frequency analysis as it investigated the signal at various bands and bandwidths. Multi-resolution filter banks is given to the input signal in the wavelet analysis. he efficient property by ehich orthogonal wavelet filter banks work is the approximation and perfect signals are achieved by utilizing the two bands of frequencies they are low-pass, and high-pass respectively.the frequency components are easily expressed in the form of 1-D data in the three-level wavelet decomposition.

The main aim of the saliency generation is to produce the features and the feature maps. These maps symbolize the center surrounded differences, by taking both the factors. The factors are local factor and global factor into consideration.

Hence, the WT with chosen levels of decomposition is capable of providing the feature maps in the band pass regions, and these will not have any content which is with lower levels of frequency content after redesigning by eliminating the approximation signals. In this paper it can be observed that without performing any data approximation smaller and higher frequency levels gets mixed and this leads to the vast errors. Anyhow, for higher levels of IWTs, bandwidths whose values are higher with huge components of frequency gets combined in the feature map after the redevelopment process. from this one can come to understand that entire reconstruction process will help in producing the feature maps which represents the edge to texture modifications.

Overview of the model proposed

The proposed framework uses the results of saliency detection and fuses them with the results of SLIC super pixel segmentation. Color features of each segment are extracted and then SVM classifier is used to identify the effected region.

SVM

This is said to be the easiest technique, that means one can understand very effectively and fastly, works appropriately, capable of understanding the algorithm. This technique is utilized for the purpose of examining the information. SVM is nothing but Support Vector Machine. It is utilized both in industries and also as the portion of the academics.

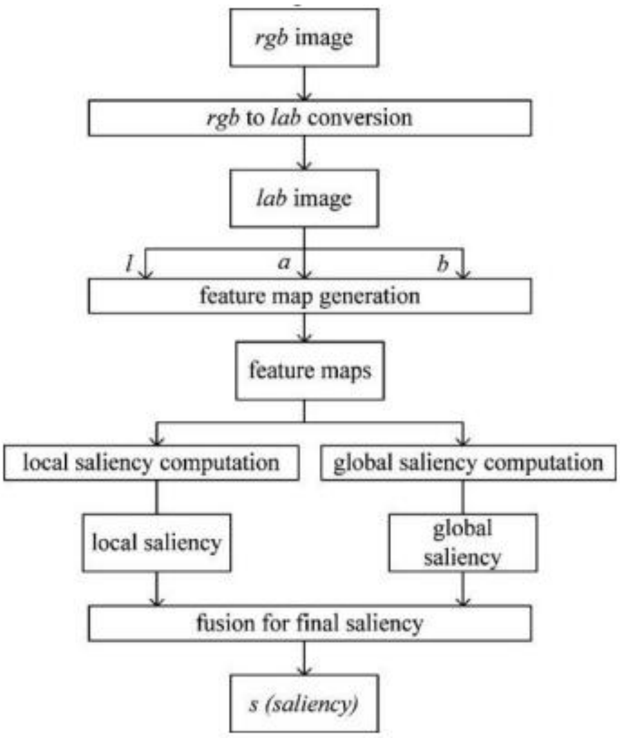

Fig 3. Flow of the projected saliency type

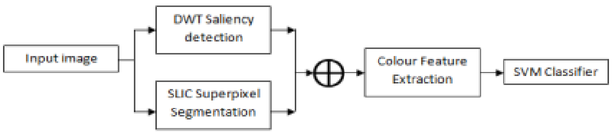

Fig 4. Block diagram of proposed Method

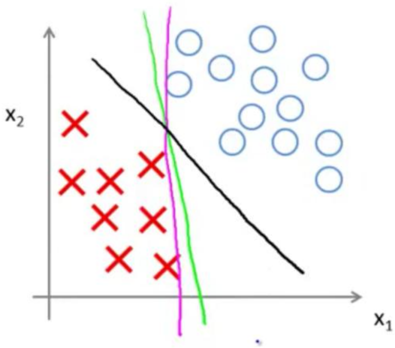

Fig 5: SVM training data sets

The complicated nonlinear capacities can be studied very easily and clearly by utilizing the SVM technique. Consider the information set that has appeared in the fig 3, with positive and negative illustrations, the information thus obtained can be detached and we can imply that there exists a straight line that can isolate the positive and negative cases effectively. The positive and negative samples are isolated using a separator which has appeared in green. There's another limit in magenta that isolates positive and negative samples marginally. In any of these cases, neither of these can be considered as a great decision. The SVM will pick this choice limit which is black in shade. This can be considered as a vastly improved choice limit than both of the alternate ones. The dark line appears like an potent separator, it improves the isolation of positive and negative cases.

Furthermore, mathematically it signifies that the SVM classifier has a greater distance in classifying the things. This distance is technically called as margin. When compared to the other two classifiers the margin for SVM is far high. As the SVM tries to increase the mrgin of classifier it can be treated as one of the most excellent classifiers. So, the SVM is sometimes called as large margin classifier.

IV. EXPERIMENTAL RESULTS

Fig 6. Input 1

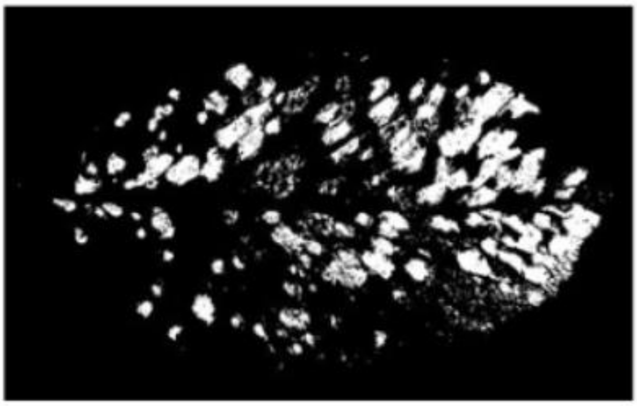

Fig 7. Output1

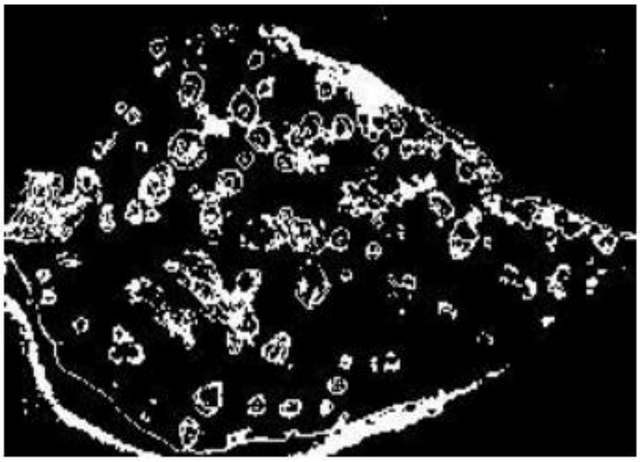

Fig 8. Input 2

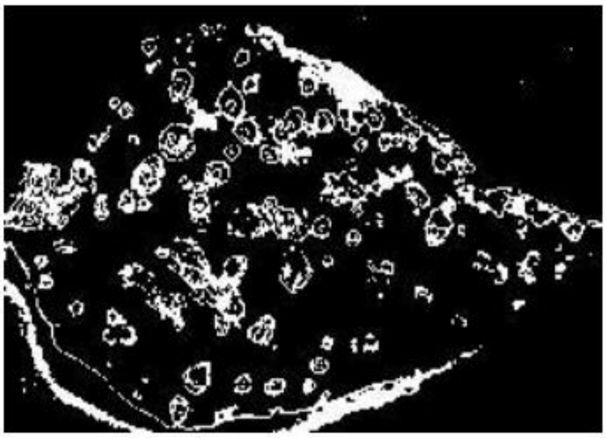

Fig 9. Output 2

Fig 10. Input 3

Fig 11. Output 3

V. CONCLUSION

Plant disease leaf picture division assumes a vital job in the plant ailment recognition through leaf manifestations. A tale division strategy for plant illness leaf picture is proposed dependent on a mixture grouping. The entire shading leaf picture is right off the bat partitioned into various reduced and about uniform super pixels by super pixel bunching. The whole color leaf image is firstly divided into a number of compact and nearly uniform super pixels by super pixel clustering, which can provide useful clustering cues to guide image segmentation. The result is fused with the result of saliency detection and then SVM classifier is used to finally detect the damaged part.

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