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Application of Image Processing Technique in Mango Leaves Disease Severity Measurement.

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Abstract **— Mango plants are affecting by different types of diseases due to which the plants cannot stay alive for a long duration. To solve the above the problem different pesticides are used, but the quantity of pesticides to be used is not well-known because the disease on the plants are seen by the naked eye only and the results may not accurate. If more number of pesticides sprayed on the Mango plants, then the Mango plants may get damage and it will affect the cost as well as the environment pollutions likes' water, air soil. In this paper we demonstrate an efficient and effective way of severity measurement of mango leaf disease using image processing techniques, in which Laplacian filter techniques are used to segment the mango leaf area & disease region area respectively. Finally diseases are categorized by calculating the percentage of disease area and total leaf area.**

Keywords **— black spot, Digital image, Disease severity, Image Segmentation, Mango leaf, Laplacian Filter.**

I. INTRODUCTION

In today's world scientist are continuously trying to increase the cultivility of crops. They have achieved this by developing the higher breed seeds and plants. But one problem still exist which is a major concern of the cultivation of crop and that is crop diseases and the pests problem. Due to these problems, the cultivation decreases and hence all the farmers and in turn the country suffers the lack of cultivation of crop.

Mango is a long duration crop and it is attacked by a number of diseases. Fungi diseases are predominant diseases which appear as spot on the leaves and it is mostly found on the Mango. These spot which is caused by fungi prevent the vital process of photosynthesis to take place, hence to a large extent it was affect the growth. If the use of pesticides is more for plant diseases treatment it increases the danger of toxic residue level on agricultural products and also it will increase the soil, water and air pollution. So this excess use must be minimized. This can be achieve by estimating severity of disease and targeting the disease places with proper concentration of pesticides.

In paper [1] simple threshold and triangle thresholding methods are used to segment the leaf area and lesion region area respectively. Finally diseases are categorized by calculating the quotient of lesion area and leaf area.

. Different pesticides are used for different disease. Tremendous uses of pesticides for plant diseases action raise the risk of poisonous residue level on agricultural crops & It has been identified as a most important supplier to ground water pollution, soil pollution, air pollution, also pesticides are increase the maximum components in the production cost [2].

The severity is been calculated by taking the area of disease part of the leaf which we get after thresholding to the total leaf area which we got after segmentation. A powerful demand now in many countries are using non-chemical control methods for diseases. That issue have not been studied more[1]. Study of diseases on the mango leaf can robustly studied by the image processing toolbox and also the diagnosis by using MATLAB helps us to suggest necessary remedy for that disease arises on the leaf of mango plant [3].

In this paper we will see an efficient and effective way of severity measurement. The Laplacian filter method was used for segmenting the leaf area and lesion area. Thus Image processing technology to measure plant disease severity is convenient and accurate. This eliminates subjectivity of traditional method and human induced errors

II. DISEASES ON LEAVES OF MANGO

The disease on the mango leaves are mainly classified in following types.

a) Bacterial disease:
b) Fungal diseases:
c) Viral disease:
d) Diseases Due To insects:

Out of the above types of disease these are dramatically affect the leaf of mango plant and its leaves. We go through the selective type of diseases on the mango leaves. Image segmentation method to detect the diseases on mango tree by scanning of mango leaves through a portable dedicated scanner. Various diseases are found on the mango tree out of this we discuss the disease some of the major diseases which are often found on the leaves of mango that are viz.fig.1and fig .2 shown below.

1) Powdery Mildew (Oidium mangiferae)

Fig. 1 Mango panicles with powdery mildew

Diseases of mango affecting approximately all the varieties. The typical pathology of the disease is the white external powdery fungal development of diseases on leaves, flowers, fruits. The affected flowers and fruits drop too early reducing the crop yield very much.

Fig. 2 Characteristic symptoms of mango powdery mildew on mango leaves..

2) Anthracnose (Colletotricchum gloeosporioides) :

It is of extensive occurrence in the field & in storage. The serious losses caused due to disease to leaf, flowers and fruits under good climatic conditions (high humidity, non-stop, rains and the temperature range of 25-35°C). Large brown lesions can affect flush leaves or older leaves. Small spots may coalesce into larger lesions. Lesions can occur on twigs and may cause tip dieback. Dark lesions may occur on young fruit or on near-mature green fruit. The disease is more common in areas where there is rain, fog and high humidity in the early season. Symptoms are worse in stressed trees.[4]

Figure 3 mango panicle infected with anthracnose disease

Fig.4 Symptoms of both anthracnose (left) and bacterial black spot (right) on mango leaves

3) Bacterial Canker (Xanthomonas campestris pv. mangiferaeindicae)

Canker is a serious disease in India. The disease causes fruitdrop (10-70%), yield loss (10-85%) and storage rot (5 100%). Many commercial cultivars of mango including Langra, Dashehari, Arnrapali,Mallika and Totapuri are susceptible to this disease. The disease is found on leaves, petioles, twigs, branches and fruits. Figure 6. Symptoms of both Bacterial Canker and bacterial black spot on mango leaves .The disease first appears as minute water soaked irregular lesions on any part of leaf or leaf lamina. Several lesions coalesce to form irregular necrotic cankerous patches. In severe infections the leaves turn yellow and drop off. Cankerous lesions also appear on petioles, twigs and young fruits. The water soaked lesions also develop on fruits which later turn dark brown to black. They often burst open, releasing highly contagious gummy ooze containing [4].

Fig. 5 Symptoms of both (left) Bacterial Canker and bacterial black spot (right) on mango leaves

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4) Bacterial black spot

This a bacterial disease of the leaves and fruit. The disease is worse in windy areas and in trees with low vigour. The disease is identified on the leaves by raised black lesions with greasy margins delineated by leaf veins. Fruit lesions initially appear as small, irregular, water soaked spots around lenticels. Later, lesions become raised with a greasy appearance, cracking, and oozing bacteria-laden sap. The disease is spread in wind-driven water from lesions to natural openings and wounds on the tree [6].

Several applications of image processing technology for biology and agriculture have been developed by scientists and engineers from Electronics Systems. Images of the mango leaves have captured by a camera. Dr. P. K. Reddy (I. I. I. T. Hyderabad) had facilitated the severity measurement of cotton leaf disease using image processing idea by agricultural expert (esagu.com) in Andhra Pradesh state. Also they used image processing idea applied for fishery [13].

III. PROPOSED METHODOLOGY

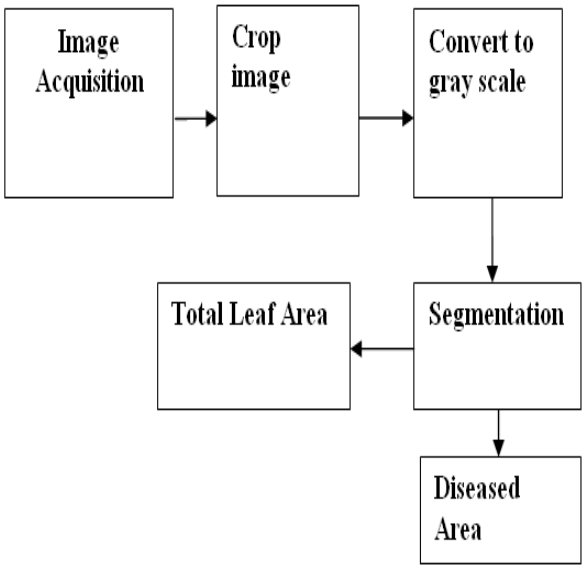

Fig. 6 Block diagram for calculating leaf disease severity.

A. Material

Black spot disease Mango leaves samples, 12 Mega pixel CIBER shot digital camera, PC, MATLAB ver.12, healthy leaf for reference.

B. Principle

Disease severity is the area of the sampling unit (leaf) viewing symptoms of disease. It is generally stated as a percentage or proportion [1]. The disease severity of the Mango leaves is measured by the disease area. The total Mango leaf area ratio. Using image processing toolbox. It can be given below.

$$ST = DA / TA \quad \ldots \quad (1)$$

$$ST = TPDA / TPA \quad \ldots \quad (2)$$

Where, ST- Severity extent, P- Unit pixel value, DA-1Diseased leaf area, TA- Total leaf area, TPDA - Total pixels in diseased area, TPA- Total pixels of leaf.

In this Mango leaves digital images all pixel represent the same size so ratio 'ST'. It can be gain by including pixels of total leaf area. Diseased leaf area in the binary image format. Then we will easily calculate standard result table of final severity in percentage [1].

C. Method

1) Image acquisition:

Mango leaves Images in database for this proposed method the image captured by using Sony CIBER shot 12 MP digital camera is preprocessed for the noise removal. The total of 150 random samples of physiologically fully grown-up &

green condition of mangoes were cropped from various farms. Different type's disease leaves are taken for the study. The different type's disease leaves are taken from the different location of Maharashtra state. They are stored in JPEG format in database folder. The disease leaf was placed flat on the white background, then leaf is zoomed or crop. So as to ensure that the images taken contain only the mango leaves. The background of image must be white color. Severity can be detected by two preliminary steps, histogram analysis and measurement of leaf area [1]

2) RGB Color Model:

The data set of the image is made by training the images. The set of values are stored in a vector by selecting the RGB color component of the image. The image given for processing its RGB color model. Is taken and the mean is been calculated, so as to get the threshold value in which the disease part is been separated. The mean value achieved by using RGB color model is used in the cyber color model. gray scale of original image was achieve by converting color image into gray image [13].

3) Leaf region segmentation :

Mango Image processing and analysis were performed by two way first is filtering and second is thresholding processes with using MATLAB software. Image filtering is an improvement operation that changes pixel values. On the basic of the grey pixel values of its close by to correct difficulty, which poor contrast or noise [3].

Input image from database is first converted into grayscale image. Since mango leaves images is taken in controlled environment. Then it place diseased leaf on the white background. It's makes big difference in gray values of two groups, first group is object & second group is background. Once image segmentation, the binary image holding leaf region is getting by region replacement and removing holes in the white region. To measure the pixels in total leaf and scan the image entirely from top to bottom and beginning left to right .

4) leaf disease region segmentation:

Segmentation of the mango leaf disease area should be perfectly Segmentation may be incorrect because of shallower midrib color than mango leaf color. Decreasing of Mango leaf color at early stages of unhealthy condition and in different types of disease occurs different stages of light, water, neutrino the disease visible various symptoms, which carry difficulties to the segmentation[1].

5) Sobel Filter :

The Sobel filter is used for segmenting the edges, basically this posses the first order derivative. The first order derivative of image is computed using gradient.First order derivative of a digital image are based on various approximation of the 2D gradients. The gradient of an image f(x,y) at location (x,y) is defind as the vector.

$$\nabla f = \begin{bmatrix} Gx \\ Gy \end{bmatrix} = \begin{bmatrix} \frac{\partial f}{\partial x} \\ \frac{\partial f}{\partial y} \end{bmatrix} \quad \ldots \quad (3)$$

It is well known from vector analysis that the gradient vector points in the direction of maximum rate of change of f at coordinates (x,y). An Important quantity in edge detection is the magnitude of this vector denoted ∇f ,Where,

$$\nabla f = mag(\nabla f) = \sqrt{Gx^2 + Gy^2} \quad \ldots \quad (4)$$

This quantity gives the maximum rate of increase of f(x,y) per unit distance in the direction of ∇f. The direction of the gradient vector also is an important quantity .Let $\alpha(x,y)$ represent the direction angle of the vector ∇f at (x,y).then from vector analysis

$$\alpha(x,y) = \tan^{-1}\left(\frac{Gy}{Gx}\right) \quad \ldots \quad (5)$$

Where the angle is measured with respect to the x axis. The direction of an edge at (x,y) is perpendicular to the direction of the gradient vector at that point. Computation of the gradient of an image is based on obtaining the partial derivative $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at every pixel pixel location.

Let the 3×3 area shown in fig.7 represent the gray levels in neighbourhood of an image.

Z1	Z2	Z3
Z4	Z5	Z6
Z7	Z8	Z9

Fig.7 3×3 region of image with Z's gray level values.

The one of the easy way to implement first order derivative at point Z5 is a sobel operator. The approach using masks of size 3×3 is given by

$$Gx = (Z_7 + 2Z_8 + Z_9) - (Z_1 + 2Z_2 + Z_3) \quad \ldots \quad (6)$$

and

$$Gy = (Z_3 + 2Z_6 + Z_9) - (Z_1 + 2Z_3 + Z_7) \quad \ldots \quad (7)$$

A weight value of 2's is used to achieve smoothing by giving more importance to the centre point. figure 8 (a) and (b)

are called sobel operator are used to implement above two equations,(d) and (e) for detecting diagonal edges [14].

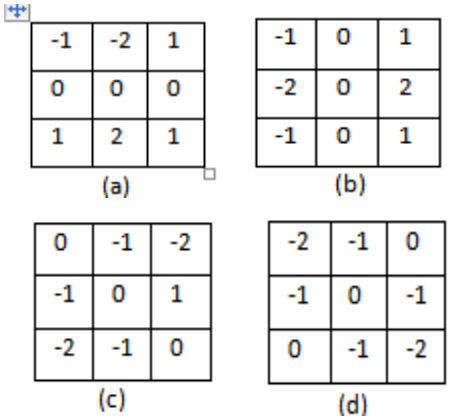

Fig.8 Sobel mask(a) and (b) sobel operator for implementing equation (6) and (7) respectively,(c) and (d) for detecting diagonal edges.

6) Laplacian filter :

Laplacian filter are used to perform on the raster image, the Laplacian filter can used to emphasize the edges in an image. This filter type is commonly used in edge-detection applications. The Laplacian is the second order derivative in which the second derivative is better suited than the first derivative for image enhancement because of the ability of the former to enhance fine detail.

First-order derivatives generally produce thicker edges in an image. Second-order derivatives have a stronger response to fine detail, such as thin lines and isolated points.

$$\frac{\partial f}{\partial x} = f(x+1) - f(x) \quad \ldots \quad (8)$$

Equation (8) Show First order derivatives generally have a stronger response to a gray-level step. Second- order derivatives produce a double response at step changes in gray level. The first order derivatives in image processing are for edge extraction, they do have important uses in image enhancement. The algorithm operates by convolving a kernel of weights with each grid cell and its neighbours in an image. Four 3x3 sized filters are available for selection. The simplest isotropic derivative operator is the Laplacian, which, for a function (image) f(x, y) of two variables, is defined as,

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} \quad \ldots \quad (9)$$

Because derivatives of any order are linear operations, the equation (9) second order Laplacian is a linear operator. In order to be useful for digital image processing, this equation needs to be expressed in discrete form. There are several ways to define digital Laplacian using neighbourhoods. Whatever the definition, it has to satisfy the properties of a second derivative. Taking into account two variables, we use the following notation for the partial second-order derivative in the *x*-direction [10].

$$\frac{\partial^2 f}{\partial x^2} = f(x+1,y) + f(x-1,y) - 2f(x,y) \quad \ldots \quad (10)$$

And, similarly in the y-direction, as

$$\frac{\partial^2 f}{\partial y^2} = f(x,y+1) + f(x,y-1) - 2f(x,y) \quad \ldots \quad (11)$$

The digital implementation of two-dimensional Laplacian Equation is obtained by summing these two components.

$$\nabla^2 f = [f(x+1,y) + f(x-1,y) + f(x,y+1) \; f(x,y-1)] - 4f(x,y) \quad \ldots \quad (12)$$

The eqn.(12) can be implemented using the mask shown in figure 9 (a) which gives an isotropic result for rotations in increments of 90°; figure 9 (b) shown below used the mask to implement the extension of equation (10) that includes the diagonal neighbours. The above figure 9 (c) and 9 (d) shows the mask of other implementation of Laplacian. Laplacian is a derivative operator; its use highlights gray-level discontinuities in an image and deemphasizes regions with slowly varying gray levels. This will tend to produce images that have greyish edge lines and other discontinuities, all superimposed on a dark, featureless background.

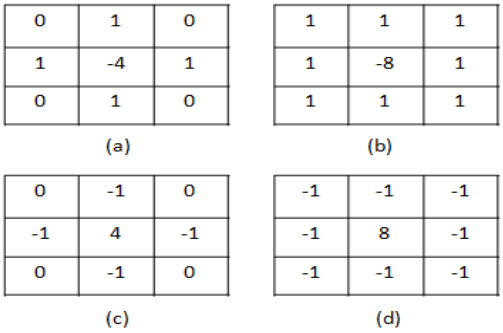

Figure 9(a) Filter mask used to implement the digital Laplacian, as defined in Eq. (11). (b) Mask used to implement an extension of Eq. (11) that includes the diagonal neighbours. (c) And (d) two other implementations of the Laplacian [11],[12],[13].

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IV. CONCLUSIONS

The accuracy of disease which was measured depends upon the segmentation of image. Here Laplacian filter and sobel filter will be used for segmentation. Previously simple thresholding method was used the disadvantage of this method is less accuracy, this advantage will be definitely remove

using sobel and Laplacian filter method. After that the results from this two methods are compare and accordingly depends on accuracy best one was selected. In future different types of filter may be used for comparison.

Thus the image processing technique to measure disease on the leaves of mangos is convenient and accurate. This will eliminates subjectivity of traditional method and human induced error. It will also help to farmers to decide the specific quantity of pesticides which will definitely reduce the cost and environmental pollution

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