International Journal of Recent Trends in Engineering & Research (IJRTER)
Conference on Recent Trends in Electrical and Electronics Engineering (RTEEE '19)
Special Issue; March- 2019 [ISSN: 2455-1457]
DOI: 10.23883/IJRTER.CONF.20190304.020.PEVMB

# DISEASE IDENTIFICATION IN SPINACH LEAVES

ROPHITA FRANKES S[1], Dr.C.SELDEV CHRISTOPHER[2]
P.G Scholar[1], Professor[2]
[1, 2]St. Xavier's Catholic College of Engineering,
Chunkankadai, Kanyakumari district Tamil Nadu, INDIA.

*Abstract–* **Agriculture is the key development in source of Indian economy. In traditional method there is no provision in identification of disease and it can be visualized only by using naked eye. By keeping this in mind this project mainly focusing in spinach leaves disease detection.Histogram equalization technique is used for adjustment of intensity and contrast of image. Using active contour image segmentation the contour energy is minimized and specifies the curve to detect the object boundaries. The mask argument specifies the initial state of the contour. Morphological operation is performed to remove small protrusions from a segmented image. By using Histogram Oriented Gradients (HOG) feature extraction the disease affected leaves are detected. Then classification is done using ANN and identified as disease and non-disease automatically which requires less computation time and a fine result is produced.**

***Keywords*—Histogramequalization, HOG, HSV, Morphological operation, Dominant color descriptor.**

## I. INTRODUCTION

Agriculture is the key development for the source of Indian economy. It is the cultivation of land to provide food, medicines and other products to sustain the life. Agriculture, for past decades, had been associated with the production of basic food crops. Now a day's agriculture and farming were not commercialized. But as the process of economic development, many more other occupations allied to farming came to be recognized as a part of agriculture. In day today life agricultural products has accepted as a part of modern agriculture.By controlling the disease that affect the plants will make reliable production of food. The proper maintenance of farm also leads to good cultivation.

The pesticide which was heavily attacked in the product is spinach. In 2016, world production of spinach was 26.7 million tonnes. Mostly it was attacked in the broader of leaves and in the seeds.
The spinach leaves disease are classified as follows they are explained below

### I.1 Anthracnose

The spinach leaves caused by the fungus Colletotrichum spinaciae is anthracnose. Symptoms of Anthracnose are characterized as small, dark olive-colored water-soaked spots. As with most anthracnose, cool (79-86F), abundant moisture conditions are ideal for this pathogen. The fungus reduces both spinach yield and quality. It also eliminates the volunteer spinach.

### I.2 Leaf miner

Spinach leaves caused by the Liriomyza chenopodii is Leaf miner. The disease is examined by serpentine mines. The photosynthetic activity gets reduced in severe cases. In severe cases the photosynthetic activity reduced and leads to death of leaves. Warm weather conditions are favourable for multiplication.

### I.3. Cladosporium Leafspot

Cladoporium Leafspot of spinach is caused by Fungus Cladosporium variable. The fungus affects the leaf spots up to 0.25 cm in the range of diameter. Fungus can grow under a wide range of temperatures, ranging from 410 to 860F.

### I.4 Downy Mildew

Downy Mildew of spinach leaves are caused by Peronospora farinose spinaciae. It will coincide with high tunnels when it is affected highly. As with most downy mildews, cool (59-700F), humid conditions are conditions are ideal for this pathogen. The symptoms is irregular yellow patches occurs on upper leaf surfaces. Lesions may eventually dry out and turn brown. Purplish-grey sporulation will be observed on the under-sides of leaves. Sporangia are produced in the morning and dispersed by wind currents over the course of the day. Infection can be latent for quite some time until conditions are favourable for disease development. Signs and symptoms sometimes appear post- harvest. Increase air circulation and reduce humidity in high tunnels. Use drip irrigation if possible.

I.5 White Rust Disease

White rust, of spinach leaves are caused by water mold Albugo occidentalis. Affected leaves are immediately removed from the spinach plant so that it will not leads to secondary infection.

The multifractal downscaling model [1] was calibrated in-order to imitate the natural things and to attenuate. A statistical metrics is used to enhance the impact of soil moisture. For segmenting the leaf region Otsu method is explained in [2]. The sobel operator is used to detect the disease spoted areas and it calculates the quotient values of the affected regions. In order to implement the K-means clustering algorithm pre-processing steps are used.NN tool is used for training and validation process. In Smartphone [3] the app which is used to activate the device is mobile app. The chambers which were acted as a waterproof are observed by using embedded camera. The sensor is also charged by using that chamber and powered by rechargeable batteries.The role of image processing in smart farming is used in [5] to detect the diseased root, stem, leaf and to avoid disease from spreading. To avoid the affected area from light HSV space is used. The parameters [6] used are soil moisture sensors, leaf wetness sensors. These sensors are the compared with threshold values of crops and specific soils. The wireless Sensor network [9] which is used to sense the parameter such as air, humidity, temperature are essential for maintaining the soil fertility. The major issue which is observed is power. A modern technique is introduced [10] to find out the fungus that mainly affects the leaves and fruits. By using naked eye observation it gives less accuracy and it is an old method. To overcome disadvantages of traditional eye observingtechnique, the digital image processing technique for fast and accurate disease detection of plant. The classifier [11] used for detection and recognition is Support Vector Machine.

The evolutionary algorithm is used [14] to generate solutions for optimization problems. A method, New Spectral Indices (NSIs) is used in [15] for identifying different varieties of diseases that occurs on the crops. The NSIs are computed by using weighted algorithm and normalized wavelength.

## II. PROPOSED METHODOLOGY

Now a day's agriculture and farming were not commercialized. But as the process of economic development, many more other occupations allied to farming came to be recognized as a part of agriculture. The Indian economy is mainly depends on the productivity of agriculture. Hence it plays a vital role in the field of agriculture. There are both bacterial and fungal diseases for plants which can destroy the whole crop like Anthracnose, mosaic, leaf spot and downy mildew and many more diseases. In traditional method plant disease is identified by using naked eye. Even-though the farmers detect disease by naked eye, it is difficult to distinguish it and it leads to reduction and loss of huge quality and quality of production. So segmentation method is used in disease detection.

In this paper detection of spinach leaves disease is done using neural network classifier. Figure 1 shows the proposed diagram of disease detection. First the image is captured after that pre-processing is done to improve the intensity of image, then the required region is being generated using initial active location and is being segmented using Active Contour Location. A special feature like Histogram Oriented Gradient (HOG) is used for feature extraction. Neural Network classifier is used to classify the image as disease or non-disease.

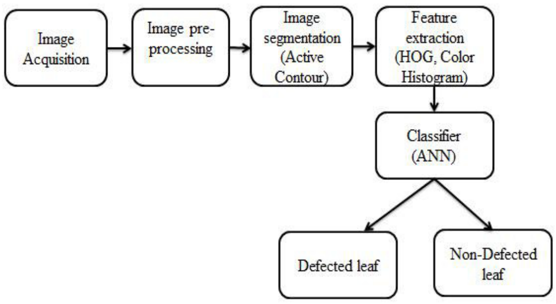



Figure1. Block diagram of disease detection

II.1 Image Acquisition

The first step is image acquisition stage. The images of the Spinach leaves are captured through the camera. . The captured images are in digital form. After capturing the image, different methods of processing is done in order to avoid errors.

II.2 Pre-Processing

The Pre-processing is done by histogram equalization technique. For segmentation process the image is needed to improve the image intensity so that the image is clearer than normally appear. This process is done by using contrast enhancement. The color conversion is given by,

$$f(x)=0.2989*R+0.5870*G+0.114.*B \qquad (1)$$

To intensify the spinach disease detection this technique is used to distribute image intensities on the captured image. This technique is also performed here to improve the contrast of captured image which stretch out the intensity range. Also this method highlights the images as foreground and background. Histogram equalisation is a straight forward technique.

The technique is used for adjusting image intensities is nothing but histogram equalization technique which is given by,

DOI: 10.23883/IJRTER.CONF.20190304.020.PEVMB

P = number of pixels with intensity n / total number of pixels (2)

Where, P denotes the normalized histogram with possible intensity

The equalized image g is defined by using,

( , ) = ( − 1) Σ( , ) (3)

Where, floor () rounds down to the nearest integer

f= image represented as a $m_r$ by $m_c$ matrix of integer

Consider the given image as 'x'. The probability of a pixel level 'i' in the image is given by equation (4),

() = ni/ ,0 ≤ < (4)

Where 'L' represents the total number of grey levels in the image;

'n' represents the number of pixels that occurred in the image. Then the cumulative distribution function of P(i) is given by using equation(5).

( ) = Σ =0 () (5)

Then calculate the intensity values by using equation (6).

$$h(v) = round\left(\frac{cdf(v) - cdf\ min}{\ }* (L-1)\right) \quad (6)$$

Where cdf(v) be the cumulative distribution function; cdf min represents non-zero minimum value. By using this image gets enhanced.

II.3.Active Contour Segmentation

After Pre-processing segmentation is done using active contour segmentation. Before starting this segmentation the image is filtered by Floyd&Steinberg filter is used to improve overall perception of image. The Active contour also called snakes is guided by constraint forces and segments an object by allowing the curve to settle in an object boundary. The predefined condition is the minimization of energy. It can also segment an image into foreground and background. The movement of snake is the energy minimization process. The external energy and internal energy are types of energies involved in active contour segmentation. Both internal and external energies are calculated for each snake points to characterize the outline shape and all elements of its own positioning of its own positioning of contour on the image takin into account the gradient lines. The external energy is defined to move the model toward object boundary. The energy controls the curve from moving to understand region. The initial stage of active contour segmentation is masking which is a binary image. White color represents the initial contour position. By using initial contour position the segmentation results obtained is faster and the output is more accurate.

Active Contour segmentation is defined in equation (7), The energy minimizing function is defined in equation (8) respectively.

$$v(s) = [x(s),y(s)], \quad s€[0,1] \quad (7)$$

where,

v(s) - energy minimization function

x(s),y(s)- time derivatives

The internal energy is both smoothness continuity of the contour

$$E_{internal}=E_{cont}+E_{curv} \quad (8)$$

Where, Econt- Energy that forces the contour to be continuous.

$E_{curv}$- Energy that forces the contour to be smooth.

Morphology is a powerful set of tools for extracting features in an image. We implement algorithms like Thinning thickening skeletons etc. The morphological operation which is sensitive to certain shapes can be constructed easily. Morphological operations mainly involve two processes such as dilation and erosion. Morphological opening examined as erosion followed by dilation and closing is examined as dilation followed by erosion. The operations are well suited to process the binary image and gray scale images. Region props are used to measure properties of image regions. It returns the measurements for the set of properties specified by the properties for the each connected components Stats is structured array containing a structure for each object in the image.

II.4 HOG feature Extraction

For object detection Histogram Oriented Gradient (HOG) which is one of the methods of feature extraction is used. This feature extraction counts the number of cells occurred in each image. Then compute HOG features for the selected ROIs and compare horizontal and vertical of the image.

Gradient,∇ = [ Gx ] = [ ∂f ] (9)

Where,computes x-gradient matrix using convolving with mask

computes y-gradient matrix using convolving with mask.

The magnitude and orientation is given by

Magnitude, √ (10)

Special Issue; March- 2019 [ISSN: 2455-1457]
DOI: 10.23883/IJRTER.CONF.20190304.020.PEVMB

Orientation, $(,) = \; ^{-1}$ (11)

Then split the image into equal cells of 8×8 pixels and block size 16×16. Enumerate a nine bin histogram for each cell and normalize the histograms with block of 2×2 cells.

$$f = \frac{v}{\sqrt{(||v^2||)+0.01}} \quad (12)$$

Where, *v* is the non-normalized vector containing all the histogram in a given block.

Then gather all the normalized histograms into an individual vector

II.5.Color Histogram

After HOG feature extraction, color histogram is used which is a portrayal of dispersal of color in an image. Here first convert the captured image into HSV image. Then quantize the HSV image into give formula,

$$H = \begin{cases} 0 & h \in [0.,360] \\ 1 & h \in [1,25] \\ 2 & h \in [26,40] \\ 3 & h \in [41,120] \\ 4 & h \in [121,190] \\ 5 & h \in [191,270] \\ 6 & h \in [271,295] \\ 7 & h \in [295,315] \end{cases} \quad (13)$$

$$S = \begin{cases} 0 & \in [0,0.2) \\ 1 & \in [0.2,0.7) \\ 2 & \in [0.7,1] \end{cases} \quad (14)$$

$$V = \begin{cases} 0 & \in [0,0.2) \\ 1 & \in [0.2,0.7) \\ 2 & \in [0.7,1] \end{cases} \quad (15)$$

Where, H-Hue represents the appearance of color

S=Saturation represents the dominance of that color

V=Value dimension represents the brightness

II.6 Neural network classifier

Then classify the selected ROIs as defected and non-defected leaf using neural network classifier because it gives a solution for complex problems. The method used to train the artificial neural network is back propagation algorithm.

## III. RESULTS AND DISCUSSION

Diseases are detected by the process of morphological opening and closing operations followed by region propping. The images are collected from in and around Kanyakumari district and are subjected to segmentation. The first step is image acquisition in which the images are captured.

Figure 2. Input image

Pre-processing is done to enhance it for segmentation. Pre-processing is generally carried out in all image processing applications especially before segmentation. In this step, contrast enhancement is carried out to make the input image clearer than normally appear. The contrast enhancement is done by using histogram equalization technique. Here Histogram equalization is performed to improve the contrast of disease image which stretch out the intensity range. Through this adjustment, the intensities are distributed.

Figure 3.Contrast Enhancement

In this step the images are segmented using active contour segmentation. The maximum n iterations is segmented in an image.

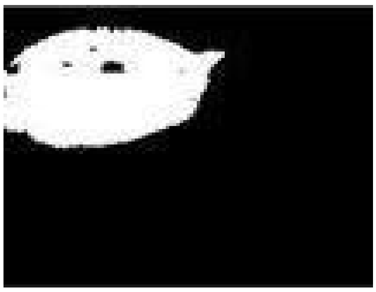


Figure 4. Active Contour Segmentation

International Journal of Recent Trends in Engineering & Research (IJRTER)
Conference on Recent Trends in Electrical and Electronics Engineering (RTEEE '19)
Special Issue; March- 2019 [ISSN: 2455-1457]
DOI: 10.23883/IJRTER.CONF.20190304.020.PEVMB

Morphological operation is used to eliminate unwanted noise such as fog, mist and much more. In this image both morphological closing and morphological opening is done. In figure 5 it performs morphological closing on the segmented image. When it removes all connected all connected components fewer than p pixels. This is known as area opening. The connectivity for this image is 50.

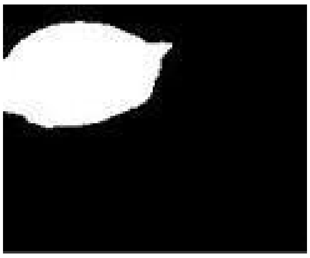


Figure5.Morphological closing

HOG feature extraction is performed on detected leaf to decompose the image into small squared cells and computes HOG on each cell.

Figure 6.HOG Visualization

The segmented image is converted to HSV image and then quantised.

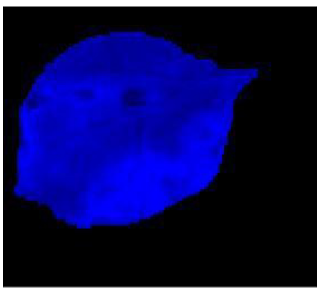
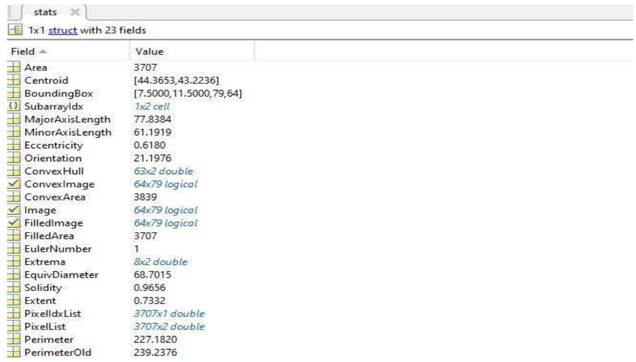


Figure7. HSV image

In this step the properties strings are given as 'all', hence area, centroid, bounding box, eccentricity etc. are computed which is shown in figure 8. The structured array used here is 'STATS'. The field of structured array denotes the different measurements of region. In this figure 8 the actual number of pixels in the region is taken as true positive value.


stats

1x1 struct with 23 fields

| Field | Value |
|---|---|
| Area | 3707 |
| Centroid | [44.3653,43.2236] |
| BoundingBox | [7.5000,11.5000,79,64] |
| SubarrayIdx | 1x2 cell |
| MajorAxisLength | 77.8384 |
| MinorAxisLength | 61.1919 |
| Eccentricity | 0.6180 |
| Orientation | 21.1976 |
| ConvexHull | 63x2 double |
| ConvexImage | 64x79 logical |
| ConvexArea | 3839 |
| Image | 64x79 logical |
| FilledImage | 64x79 logical |
| FilledArea | 3707 |
| EulerNumber | 1 |
| Extrema | 8x2 double |
| EquivDiameter | 68.7015 |
| Solidity | 0.9656 |
| Extent | 0.7332 |
| PixelIdxList | 3707x1 double |
| PixelList | 3707x2 double |
| Perimeter | 227.1820 |
| PerimeterOld | 239.2376 |

\

Figure 8Computed property strings values

## IV. PERFORMANCE ANALYSIS

The performance of the disease detectionis analysed and the information regarding the performance of individual, group etc., are collected. The images chosen for performance analysis were shown below. Eight images are used here as test images. The images are of size MXN where the M and N can vary. The performance does not change even if the size of the images varies. The images used as test images are shown in Figure 9

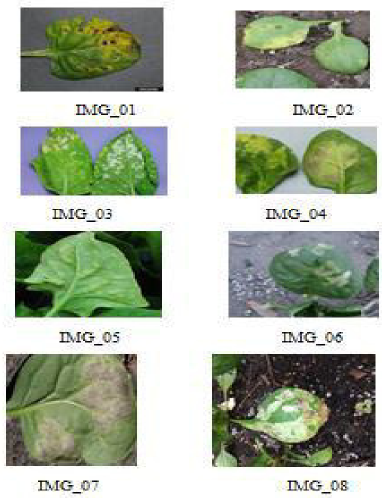



Figure 9Test images

Accuracy measures the proportion of excellent and poor leaves those are selected correctly to the total number of excellent and poor leaves.

$$ACC = \frac{(TP + TN)}{(TP + FP + FN + TN)}$$

Where,

TP represents the number of True Positive value

TN represents the number of True Negative value

FP represents the number of False Positive value

FN represents the number of False Negative value

Table 1 shows accuracy values using artificial neural network

| Images | No of True positive(TP) | No of True Negative(TN) | No of False Positive(FP) | No of False Negative(FN) | Accuracy (ACC) |
|---|---|---|---|---|---|
| IMG_01 | 6965 | 10 | 300 | 5 | 95.8% |
| IMG_02 | 3635 | 25 | 100 | 50 | 96.06% |
| IMG_03 | 5781 | 250 | 125 | 75 | 96.7% |
| IMG_04 | 4192 | 0 | 75 | 25 | 97.6% |
| IMG_05 | 12425 | 75 | 35 | 28 | 99.4% |
| IMG_06 | 4057 | 25 | 25 | 5 | 99.2% |
| IMG_07 | 31922 | 15 | 50 | 25 | 99.7% |
| IMG_08 | 7964 | 0 | 25 | 5 | 99.6% |
| Average | | | | | 98.7% |

From the above table, it can be proved that the artificial neural network gives fine result with the accuracy of 98.7%. Hence this method can used to detect the spinach leaves disease and can be used in many image segmentation applications.

## V. CONCLUSION

Images are captured and it is pre- processed to enhance it for segmentation. The histogram equalisation technique is used to improve the contrast of disease image which stretch out the intensity range. By using active contour image segmentation images are segmented into foreground and background. The HOG feature extraction is performed on segmented imageTo classify defected and non-defected leaf artificial neural network toolbox is used. The disease detection can also be controlled by using IOT.

## VI. REFERENCES

1. Ara Ko, Giuseppe Mascaro, and Enrique R. Vivoni (2016) 'Irrigation on Scaling Properties of Soil Moisture and the Calibration of a Multifractal Downscaling Model', IEEE Transaction on Geoscience and Remote Sensing, pp.1-15

2. H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. A. L. Rahamneh(2011) 'Fast and Accurate Detectionand Classification of Plant Diseases', International Journal of Computer Applications, Vol.17– No.1,pp.32-38.

3. Joaquín Gutiérrez, Juan Francisco Villa-Medina, AracelyLópez-Guzmán, and MiguelangelPorta-Gándara 'Smartphone Irrigation Sensor', IEEE Sensor journal, pp.1-7,2015.

4. Kiran R. Gavhale, and U. Gawande, 'An Overview of the Research on Plant Leaves Disease detection using Image Processing Techniques' IOSRJournal of Computer Engineering,vol. 16,Issue.1, PP 10-16,2014.

5. Monica Jhuria, Ashwani Kumar, and RushikeshBorse, 'Image Processing For Smart Farming: Detection Of Disease And Fruit Grading', IEEESecond International Conference on Image information processing, pp.521-526,2014.

6. Ms.Yashaswini ,Ms.Sinchana,Ms.Vani,Mr. Nithin Kumar 'Smart Automated System and Plant disease Prediction' IEEE International Conference on Power, Control, Signals and Instrumentation Engineering,pp.422- 427,2017.

7. Nadine Jaan D. Caldito, Eusebelle B. Dagdagan, Mark G. Estanislao, ,Marissa G. Chua, Jeffrey F. Calim, Florocito S. Camata ' A Leaf Recognition Of Vegetables Using Matlab',International Journal of Scientific & Technology Research ,Vol. 5, Issue 02,pp.38-42,2016.

8. Nikos Petrellis, 'Plant Lesion Characterization for Disease Recognition Using Window Phone Application',2nd International Conference on Frontiers of Signal Processing,pp.10-14,2016.

9. PravinaB.Chikankar,DeepakMehetre, SoumitraDas ' An Automatic Irrigation System using ZigBee in Wireless Sensor Network', IEEE International Conference on Pervasive Computing (ICPC),2015 .

10. SandeshRaut, AmitFulsunge ' Plant Disease Detection in Image Processing Using MATLAB', International Journal of Innovative Research in Science, Engineering and Technology Vol. 6, Issue 6,pp.10373-10381,2017.

11. .Saradhambal.G, Dhivya.R, Latha.S, R.Rajesh 'Plant Disease Detection And Its Solution Using Image Classification' ,International Journal of Pure and Applied Mathematics Vol. 119, No. 14,pp.879-884,2018.

12. SindhujaSankarana, AshishMishraa, Reza Ehsania, Cristina Davisb 'A review of advanced techniques for detecting plant diseases Computers and Electronics in agriculturesvol-72,pp.1-13,2010

13. Sumit S. Thote and Prof. Mrs. Snehal A. Bhosale 'Smart Irrigation System: Plant Diseases Recognition using IP', International Journal of Engineering Technology Science and Research,Vol.3,Issue.2,pp.35-42,2016.

14. Vijai Singh , A.K. Misra 'Detection of plant leaf diseases using image segmentation and soft computing techniques',Information processing in agriculture, pp.41-48,2017.

*Special Issue; March- 2019 [ISSN: 2455-1457]*
DOI: 10.23883/IJRTER.CONF.20190304.020.PEVMB

15. Wenjiang Huang, Qingsong Guan, JuhuaLuo, Jingcheng Zhang, Jinling Zhao, Dong Liang, Linsheng Huang, and Dongyan Zhang 'New Optimized Spectral Indices for Identifying and Monitoring Winter Wheat Diseases', IEEE Journal Of Selected Topics InApplied Earth Observations And Remote Sensing,Vol.7,No.6, pp.2516-2524,2016.

16. Yuta Kawakami, Takashi Furuta, Hideto Nakagawa, Taichi Kitamura 'Rice Culture Support system Equipped with Water-Level Sensor System',IFAC,pp.143-148,2016.