PLANT DISEASE DETECTION USING FUZZY SUPPORT VECTOR MACHINE

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Abstract: The self-starting detection of leaf disease is necessity topic as it is an advantage in monitoring large crop fields. The existence of disease in plant means the growth of plant can be destroyed. In this computing stage image processing techniques are used to study the various plants leaf diseases. In this paper we apply a methodology that is based on Fuzzy based system and used segmentation to distinguish critical or non-critical section to detect plant disease. First of all image is pre-processed, and then segmentation is done by using SVM technique and at the last classification is done by using FSVM method. The simulation results shows that the overall accuracy is improved and MSE reduced by 10%.

Keyword: MSE, SVM, Plant Disease.

INTRODUCTION

Plant disease detection causes determination of crops and loss in terms of financial condition of the farmers. India is a farming nation here major part of the economy depends upon the crops and plants. Deterioration in plants causes diseases as well as financial loss. Quick detection and prevention of diseases within plants is the prime cause of concern with proposed system.

[1]To identify the diseases at early stage, several strategies were researched over. Machine learning mechanisms are most common which are discussed in this section. Segmentation strategies including support vector machine divides the images into hyper planes.[2] Multiple hyper planes indicate multiple diseases. Support vector machine however cannot classify numerical data. Also nominal values are difficult to tackle using this strategy.

Larger datasets are difficult to handles using support vector machine. In order to handle the issue convolution network is constructed in proposed system. [3]The entire process followed within the proposed system is divided into parts

These parts are discussed as: first section includes pre-processing. [4]This phase is used to handle the noise within the images. Noise and contrast enhancement is critical in order to identify the disease accurately from within the image. Next phase is feature extraction and segmentation. Segmentation is the technique of splitting the image into critical and non-critical parts. Features extracted are divided into following parts

- Mean

This is used to obtain average value of the features obtained from the presented image. Using following equation find mean

$$Mean = \sum \frac{X_i}{N} * (Total_{Features})$$

Xi is the sum of total values and N is the total pixels present within the image. Total features indicate the maximum features present within the image.

- Median

Median is used to denote the middle value of the series. In case series contains even number of terms then median values are obtained as

Median=(Image_Size*N)/2

Image size is presented in terms of resolution of the image. Median in case series of odd number terms is calculated as

Median=Image_size*(N+1)/2

- Standard Deviation

This is a statistical measure used to estimate the deviation of obtained result from the actual result. Its value can either be +ve or -ve.

$$\text{Standard Deviation}=\sqrt{\sum \frac{(x-x_i)^2}{N}}$$

X is the actual value x_i is the approximate value, and N are the entire number of terms within the distribution.

- Mean Deviation

Mean deviation is similar to standard deviation with the difference that its values is always positive and lies between 0 and 1.

Mean_Deviation=abs(Standard_Deviation)

- RMS

Defined the interrelationship of segments with each other. Higher the value of RMS more relatedness is discovered.

- Entropy

Entropy defines degree of relationship between pixels. Higher the entropy more accurate will be the results.

In addition several other parameters are extracted for evaluation and classification within the proposed system.

[5], [6] The management of disease is a testing task. Generally, diseases are seen on the leaves or stems of the plant. Exact measurement of these outwardly watched diseases, bugs, qualities has not contemplated yet in light of the many-sided quality of visual examples. Henceforth there has been expanding interest for more particular and advanced image design understanding.

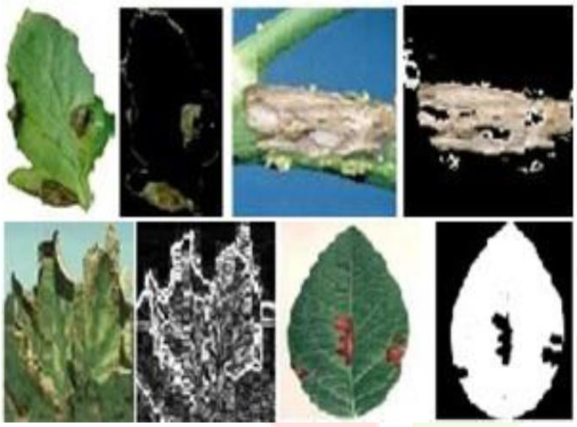


Figure 1: Image analysis of various leaves

[7], [8] Most plant leaf diseases are caused by fungi, bacteria and viruses. Fungi are recognized basically from their morphology, with accentuation set on their regenerative structures. Bacteria are viewed as cruder than fungi and for the most part have less difficult life cycles. With couple of special cases, bacteria exist as single cells and increment in numbers by separating into two cells amid a procedure called parallel splitting viruses are to a great degree modest particle comprising of protein and hereditary material with no related protein [9]. In organic science, at times a huge number of images are produced in a solitary analysis. There images can be required for additionally considers like arranging lesion, scoring quantitative attributes, figuring zone eaten by bugs, and so forth.

[9], [10] All of these undertakings are prepared physically or with particular programming bundles. It isn't just gigantic measure of work yet additionally experiences two noteworthy issues: exorbitant handling time and subjectiveness ascending from various people. Consequently, to direct high throughput tests, plant scientist requires proficient PC programming to naturally extricate and investigate critical substance. Here image handling assumes essential part. In this paper we introduced a technique to handle plant disease using CNN and SVM based technique.

Paper is organised as under: section 2 gives the literature survey of the techniques used to evaluate the problems within image datasets, section 3 gives the information about the dataset, section 4 gives the proposed system, section 5 gives the performance analysis and results, section 6 gives the conclusion and future scope, section 7 gives the references.

RELATED WORK

Literature survey gives the details of techniques used to evaluate accuracy of mechanism used. Error within the obtained result is high which can be further reduced.

[11]proposed a mechanism to handle disease related to apple fruit. Linear binary patterns are analysed in this case. The results are offered in the form of classification accuracy. Linear binary patterns are consulted using the features like kurtosis; mean, median etc. result does not show great deviation as the noise is introduced within the image.

[12]proposed a mechanism to accurately classify the image. Image dataset used is derived from online source. Random forest algorithm is used for evaluating the image set. Classes are limited in this case. Hence classification accuracy is poor in this case.

[13]proposed a stone disease detection mechanism. Large numbers of techniques are surveyed for detecting best possible mechanism to tackle the disease within the fruit. Machine learning mechanisms are limited with unsupervised learning. Classification accuracy can further be improved considering convolution neural network.

[14]proposed a fungal disease detection mechanism. Citrus fruits are considered for evaluation. Citrus fruits are part of critical fruits containing vitamin C. Detection of disease at early stage can cause substantial increase in classification accuracy.

[2]proposed a fruit disease detection mechanism. The features are takeout and then result is fed into segmentation phase. After performing segmentation, classification is performed. Classification is used to categorize the ailment if any from within the plant image. Result is obtainable in terms of classification accuracy and mean square error.

[15]proposed a vegetable and crop disease detection mechanism. The feature extraction mechanism is used in order to fetch the features from the image. After the features are extracted, segmentation is performed. Segmentation splits the image into critical and non-critical segments. Classification accuracy is observed to be high in this case.

Literature survey recommends that limited work has been done to detect disease in case of plants.

DATASET USED

The dataset used is derived from the GitHub website. Dataset contains plants disease images. The size of the images used is 512x512 and extension is jpg. The dataset information is given as under

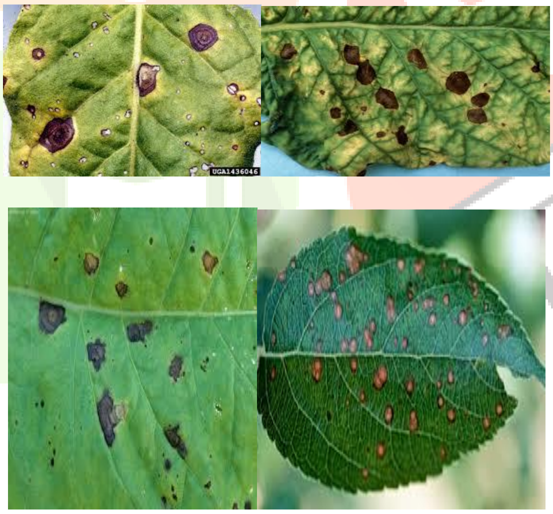


Figure 2: Alternaria Alternata Disease dataset

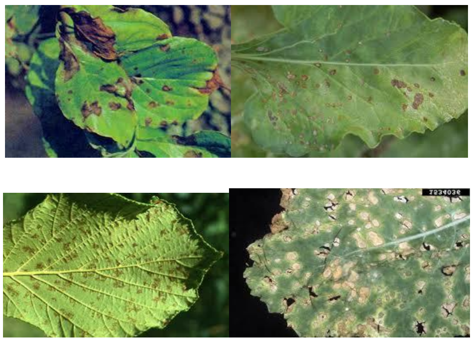


Figure 3: Bacterial blight disease dataset

Figure 4: Anthracnose Disease dataset

Figure 5: Cercospora Disease dataset

This dataset used is derived from online source and pre-processing mechanism is applied. Pre-processing is used to handle the noise from within the image. Detailed methodology is given as under:

PROPOSED METHODOLOGY

Proposed system consists of phases. The methodology of the planned system is given as under

I. First of all input the data set

This phase obtained the image from classification. In addition the dataset, available is buzzed into the system. Images are maintained within the buffer for further processing.

II. Perform the pre-processing step.

The pre-processing phase is used to extract the problems from within the image and tackle those problems by the use of Gaussian filtering mechanism. The methodology for the same is given as under

Equation 1 gives the operation of filtering along with smoothening.

$$G_{Smoothened_{image}} = \frac{1}{2\pi\alpha^2} e^{(a^2+b^2)\frac{1}{2a^2}}$$

***Equation 1:** Gaussian Filtering*

'α' is standard deviation, 'a' is distance from horizontal axes and 'b' is a distance of origin from vertical axes.

After handling noise, resizing operation is done. Resizing is done to present the uniform data to the input layer. Resizing is done using equation 2.

$$Resized_G = Resize\left(G_{Smoothened_{image}}, [70\ 100]\right)$$

***Equation 2:** Resized image*

This resized image set obtained is passed to the network for further processing.

III. Apply the segmentation mechanism in order to separate the critical section from non-critical section

The segmentation mechanism divides the image into critical and non-critical segments. Support vector machine is used for this purpose. Support vector machine which is used divides the image into hyper-planes. The hyper-planes identify the threshold values' corresponding to which disease is predicted.

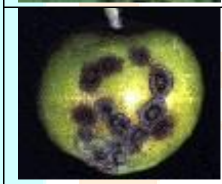
IV. Perform the classification using Fuzzy Support vector machine.

Fuzzy based SVM is used for classification purpose. Result is compared with the existing MSVM classification to prove worth of the study.

PERFORMANCE ANALYSIS AND RESULTS

As compared with existing technique without fuzzy system, result improves considerably. The tabular representation and graphs describe the same. The following table give affected area detected through existing and new approach

Table 1: Comparison in terms of Affected Area Detected

Image	Existing Without Fuzzy(%)	New With Fuzzy(%)
	27.8971	26.789
	18.3638	18.3638
	24.0837	27.1981
	31.8792	28.761

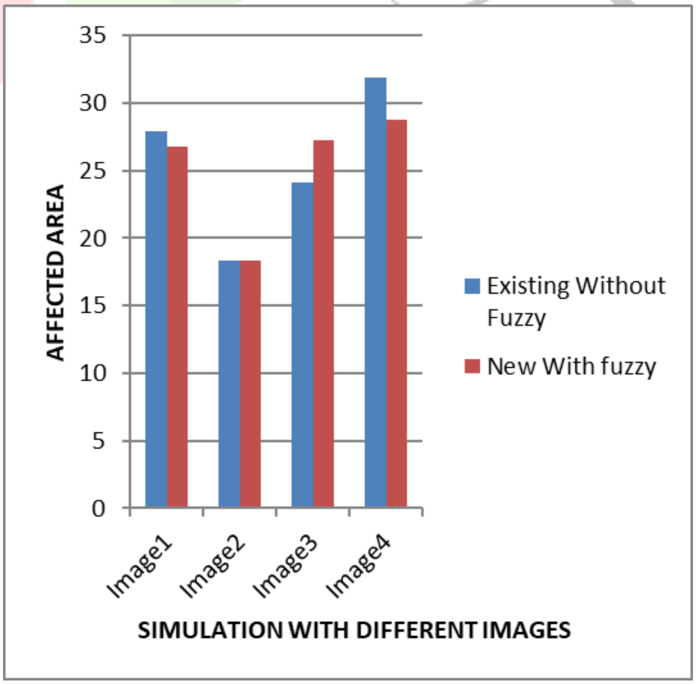
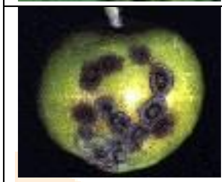


Figure 6: Affected Area Detection Comparison of Exiting and New Approach

The affected area in terms of existing technique detected is more hence including those areas which may not be affected. New approach on the other hand introduces precision and gives accurate area of infection. Comparison in terms of accuracy is given as under

Table 2: Comparison in terms of Accuracy

Image	**Existing Without Fuzzy (Accuracy)**	**New With Fuzzy (Accuracy)**
	97.8971	99.2789
	96.6578	99.8762
	95.567	99.04523
	96.345	99.2345

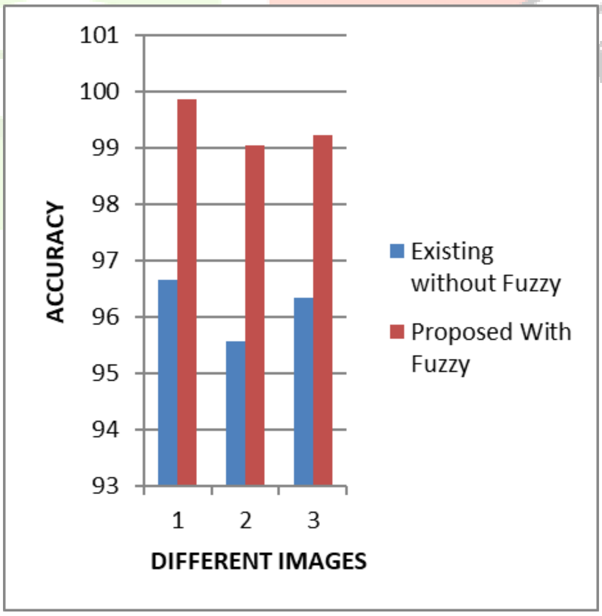
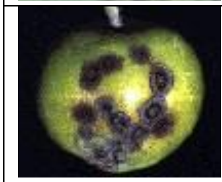


Figure 7: Accuracy Comparison of Existing and New Approach

The observed entropy is in the range of 7 to 8 for the new system. The entropy describes degree of relationship between pixels. Overall new system with Fuzzy SVM produces better result as compared to existing system without fuzzy.

Table 4: Comparison in terms of Entropy

Image	Existing Without Fuzzy (Entropy)	New With Fuzzy (Entropy)
	5	7
	4	8
	6	7
	5	8

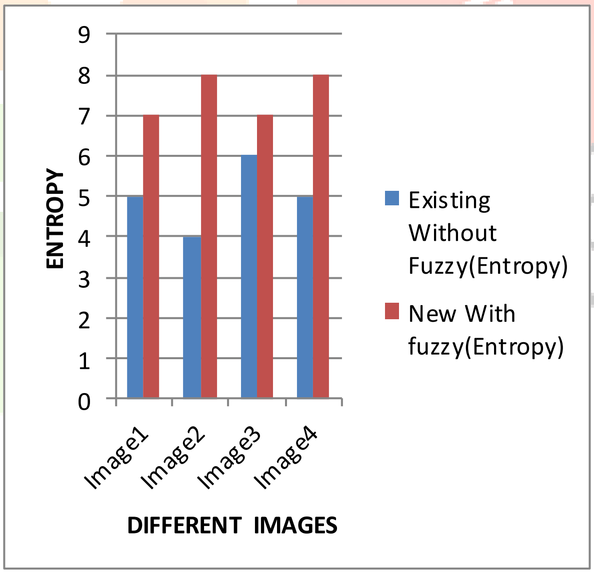


Figure 8: Entropy Comparison of Existing and New Approach

Overall result and performance analysis indicates better performance of the new mechanism as compared to existing approach.

CONCLUSION AND FUTURE SCOPE

To prevent agricultural loss the classification and detection of leaf disease accurately is must. There are classifier and technique to recognize plant disease. In any case, in this examination work, we are utilizing image preparing system for the discovery of plant leaf diseases. A structure for the outline of plant leaf disease location is given her its work process. Dataset for the proposed idea is set up with the plant leaf endured with diseases Cercospora Leaf Spot, Bacterial Blight, Anthracnose and Alternaria Alternata. In this paper we propose a technique based on segmentation and FSVM to detect leaf disease. The experimental result shows that accuracy is improved and MSE is reduced.

In future, we can use optimization mechanism like genetic approach with the proposed mechanism for result enhancement.

References

[1] K. Khan, "The Evaluation of Well-known Effort Estimation Models based on Predictive Accuracy Indicators," *IEEE*, no. January, 2010.

[2] J. G. Barbedo, "Digital image processing techniques for detecting, quantifying and classifying plant diseases.," *Springerplus*, vol. 2, no. 1, pp. 660–671, 2013.

[3] I. Kaur, G. Aggarwal, and A. Verma, "Detection and Classification of Disease Affected Region of Plant Leaves using Image Processing Technique," *Indian J. Sci. Technol.*, vol. 9, no. 48, pp. 1–13, 2016.

[4] V. Singh, "Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm," *ACM*, pp. 1028–1032, 2015.

[5] S. D. Khirade, "Plant Disease Detection Using Image Processing," *IEEE Access*, pp. 1–4, 2015.

[6] T. Bogodorova, S. Member, L. Vanfretti, and S. Member, "Identifying Uncertainty Distributions and Confidence Regions of Power Plant Parameters," *Springer*, pp. 19213–19224, 2017.

[7] S. D. Khirade and A. B. Patil, "Plant Disease Detection Using Image Processing," *2015 Int. Conf. Comput. Commun. Control Autom.*, pp. 768–771, 2015.

[8] S. K. Tichkule, "Plant Diseases Detection Using Image Processing Techniques," *ACM Comput. Surv.*, pp. 1–6, 2016.

[9] J. Cai, "Robust Filtering-Based Thinning Algorithm for Pattern Recognition," *IEEE*, vol. 55, no. 7, 2012.

[10] S. K. Pilli, B. Nallathambi, S. J. George, and V. Diwanji, "eAGROBOT- A Robot for Early Crop Disease Detection using Image Processing," *ACM Comput. Surv.*, 2012.

[11] S. R. Dubey, "Detection and Classification of Apple Fruit Diseases using Complete Local Binary Patterns," *IEEE 2nd Int. Smart Cities Conf. Improv. Citizens Qual. Life, ISC2 2016 - Proc.*, 2012.

[12] B. J. Samajpati and S. D. Degadwala, "Hybrid Approach for Apple Fruit Diseases Detection and Classification Using Random Forest Classifier," *IEEE*, no. 2013, pp. 1015–1019, 2016.

[13] S. Von Broembsen and P. W. Pratt, "Common Diseases of Stone Fruit Trees and Their Control," *IEEE 17th Int. Conf. Parallel Distrib. Syst.*, 2015.

[14] M. Dewdney, "Fungal Diseases of Citrus Fruit and Foliage Foliar Fungal Diseases to be Covered," *IEEE 17th Int. Conf. Parallel Distrib. Syst.*, 2014.

[15] "SURVEY ON MAJOR DISEASES OF VEGETABLE AND FRUIT CROPS Total Number of leaves / Fru it counted Sum of all disease ratings × 100 Total number of leaves / fru its × maximum rating value," vol. 35, no. September, pp. 423–429, 2010.