DISEASE AND PEST DETECTION IN VARIOUS LEAF IMAGES USING IF SET OSCILLATION

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ABSTRACT

This paper presents early detection of pest and disease region by using IF set oscillation. The task of automated method is applied to early detection of pest and diseases in various leaves assists to improve the economic level of agriculture growth and reduce the pesticides usages. The greenhouse staffs are very difficult to monitor the plant disease and pest through manually. Hence, Digital Image Processing acts an important role to identify the pest and disease from various leaf images. This proposed work consists various level such as image acquisition, preprocessing and IF set oscillation based segmentation. This process reduces the manual work.

Key Words: IF (Intuitionistic Fuzzy set) oscillation, segmentation, Digital Image Processing.

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1. INTRODUCTION

Agriculture plays a vital role in Indian economy. Over 58 percent of the rural households depend on agriculture as their principal means of livelihood. The Indian food industry is poised for huge growth, increasing its contribution to world food trade every year due to its immense potential for value addition, particularly within the food processing industry. There is an urgent need to step up collective efforts to fight fast-spreading, cross-border animal and plant pests and diseases that could threaten global food security. This was the core message of representatives of more than 20 countries, assessing the impact of three major pests and diseases. The meeting was organized by FAO, World Organization for Animal Health (OIE), Bioversity International, World Banana Forum and donors to mobilize more support to effectively and sustainably prevent, manage, and – if feasible - eradicate the major pests and diseases. "Invasive pests and diseases are the second most important threat to nature due to their severe impact on populations' livelihoods; on the health of people, animal and plants; and on the economy. They are affecting those most vulnerable – the poorest farmers, and can ultimately threaten food security on a global scale," said Ren Wang, Assistant Director-General, Agriculture and Consumer Protection Department of FAO. A pest is an organism that spreads disease, causes damage or is a nuisance. Most of the pests that affect plants rapidly are whiteflies, aphids, fungus, gnats, flies, thrips, slugs, snails, mites and caterpillers. Whiteflies and aphids widen virus on entire plants and trees. Only way to reduce the pest by using pesticides, it is very harmful to plant and reduced the biodiversity in soil. Pests lead to episodic outbreaks of diseases, which lead to famine and food shortage. The plant diseases are very annihilate as a lot of farmers were discouraged to the point where some decided to give up the work of crop cultivation. The manual method is too complicated to diagnose the plant diseases in total leaf area in greenhouse compare to automatic detection.

The digital image processing is playing vital role to detect diseases in agriculture field. Image processing technique such as machine vision system has been proven to be an effective automated technique. Image processing based Intuitionistic fuzzy oscillation can reduce the computational time and as a result, the automated diseased and pest detection in leaf can be made much faster. Fuzzy logic has been employed to handle the concept of partial truth. The idea of fuzzy set is gratified because it handles uncertainty and vagueness which Cantorian set could not address.

In fuzzy set theory, the membership of an element to a fuzzy set is a single value between zero and one. However in reality, it may not always be true that the degree of non-membership of an element in a fuzzy set is equal to 1 minus the membership degree because there may be some hesitation degree. Therefore, a generalization of fuzzy sets was introduced as Intuitionistic fuzzy sets (IFS) which incorporated the degree of hesitation called hesitation margin. The Oscillatory region concept of a fuzzy set which means the oscillation of a fuzzy set occurs between at least two fuzzy open set and two fuzzy closed set. In case of images of different gray level, it is not mandatory that an image having a membership value at any pixel point has 1-membership value at another gray level. It may be less than 1-membership value. So image of different gray level cannot be solved by fuzzy set. So we need IF Set. That is why in this paper IF Set oscillation is considered for Leaf image.

In this proposed work,we used the following definitions:

Definition 1: Let X be a nonempty set. A fuzzy set A drawn from X is defined as $A=\{< x,\mu_A(x)> :x\in X\}$, where $\mu_A(x)$: $X\rightarrow[0,1]$ is the membership function of the fuzzy set A.

Definition 2: Let X be a nonempty set. An intuitionistic fuzzy set (IFS) A in X is an object having the form $A= \{<x,\mu_A(x),\nu_A(x) >: x\in X\}$, where the functions $\mu_A(x),\nu_A(x)$: $X\rightarrow[0,1]$ define respectively, the degree of membership and degree of non-membership of the element $x\in X$ to the set A, which is a subset of X, and for every element $x\in X$, $0\leq\mu_A(x)+\nu_A(x) \leq 1$. Furthermore, we have $(x) = 1-(x) - \nu_A(x)$ called the intuitionistic fuzzy set index or hesitation margin of x in A. (x) is the degree of indeterminacy of $x\in X$ to the IFS A and $(x)\in[0,1]$ i.e.,$\pi_A(x): X\rightarrow 0,1$ and $0\leq\pi_A\leq1$ for every $x\in X$. (x) expresses the lack of knowledge of whether x belongs to IFS A or not.

2. LITERATURE REVIEW

In 1965the concept of fuzzy logic was first conceived by Professor Lotfi A. Zadeh University of California Berkely [17]. Fuzzy logic is used to monitor non linear systems which are difficult to deal mathematically. In the beginning of last century L. Brouwer introduced the concept of Intuitionism. The concept of the intuitionistic fuzzy set (IFS) proposed by Atanassov [2] is a generalization of the fuzzy set. One of the Characterizations of the IFS is that it assigns to each element a membership degree and a non-membership degree rather than the membership degree only. The IFS is more flexible and practical for dealing with vagueness and uncertainty than the ordinary fuzzy set in many real situations. We select the domain of IFS for actually two reasons. (i) Fuzzy sets employ calculations with very small values [0, 1]. So it directly deals with the pixel values. (ii) IFS is also concern with the pixel values which are not in the particular range. The Oscillatory region concept of a fuzzy set which means the oscillation of a fuzzy set occurs between at least two open and closed set, was initially introduced A. Mukherjee and S. Halder in 2007 [18].Various existing methods are applied to segmented the leaf diseases, image is converted to hue component then separated and mask the green mask [3]. Crops also affected by various diseases and pest, this kind of problems also solved by knowledge based techniques with image processing algorithms. Various kind of image processing segmentation methods is used current research arena. The segmentation type such as feature-space based, image domain based and then edge based methods [8]. The segmentation is vital role in image processing, it is applied to segmented the image region for more meaningful. Now-a-days, Artificial Intelligence (AI) of fuzzy computation is play important role for many intractable problems. High quality research is based upon AI.

a) Image characteristic:
In agricultural Image processing, image is processed through various computerized techniques. Various disease and pest affected the leaf regions. Whiteflies are most dangerous pest, it is spread the virus for whole complete tree. Greenhouse staffs where noticed the disease on leaves on various trees, it is very time consuming process. But analyzed the greenhouse through video, it is captured the images on sequence frame. Sequentially applied the powerful algorithm to this digitized image for detects the various pest affected parts accurately. Early detection of both pest and disease detection which has improve the food quality and economic level.
Overcome the problems
- Digitized image may be suffered from noise and poor enhancement quality. By overcome this problem to apply various enhancement techniques.
- Reduced the manual work.

b) Study Area:
Computer vision and Image Processing techniques are new and important problem solving in agricultural field. These techniques are helps to detect as dark parts on leaves, cracks and contusion on fruits and seeds, etc. Image enhancement and segmentation methods are acting a most significant role on pest detection. In existing methods are such as threshold, k-means segmentation, watershed and fuzzy c-means segmentation. In our proposed work, we are applied intuitionistic fuzzy oscillation set, it is assist to improve the segmentation level and conquer the oversegmented problems.

3. METHODOLOGIES

In this section IF oscillation set is applied to detect the pest and then diseased leaves. This proposed method consist image acquisition, preprocessing, segmentation and region extraction is shown on Figure1. Existing method was compared to new algorithm of IF oscillation.

A) Image acquisition

Image is acquired through agricultural database. An image is defined by mathematical function f(x, y) where a and y are the two co-ordinates parallel and vertically. The value of f(x, y) at whichever points is present the pixel value at that point of an image.
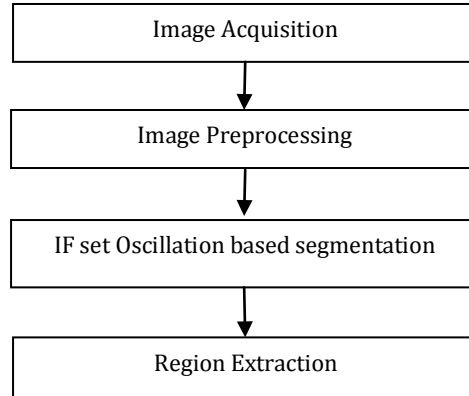
Figure-1: The flowchart for proposed work

B) Image preprocessing

Color normalization is applied to improve the brightness of the image. It is help to improve the segmentation accuracy level. In this proposed work, we are applied histogram stretching for change the range of pixel intensity level.

C) IF set Oscillation Based Segmentation

After, preprocessed image is supplied as an input to the segmentation process. Image segmentation plays an important role in image processing. Algorithm for IF set oscillation based segmentation

Step 1: Read the preprocessed image. f(x, y) is considered as a original image. After preprocessed image is consist g(x, y).

Step 2: Fuzzify the preprocessed image with triangular membership function

Step 3: applied an open and closed set to segment the region from the background.

Step 4: followed by find the leaf diseased and infected region using IF Oscillation.

Step 5: a) Let X be a Leaf.

b) An IF set A in X is an object having the form $A = \{\langle x, \mu_A(x), \nu_A(x)\rangle : x \in X\}$, where the functions $\mu_A(x), \nu_A(x): X \to [0,1]$ define respectively, the degree of membership and degree of non-membership of the element $x \in X$ to the set A, which is a subset of X, and for every element $x \in X$, $0 \leq \mu_A(x) + \nu_A(x) \leq 1$. Furthermore, we have $(x) = 1 - \mu_{A}(x) - \nu_A(x)$ called the intuitionistic fuzzy set index

c) Choose the IF open sets such as $\lambda_1, \lambda_2, \lambda_3, ..., \lambda_n$ and the IF closed sets $\lambda_1^c, \lambda_2^c, \lambda_3^c, ..., \lambda_n^c$

d) Find $\sup(\lambda_1, \lambda_2, ..., \lambda_n)$ and also find $\inf(\lambda_1, \lambda_2, ..., \lambda_n)$

e) IF oscillations $O_{\lambda_1, \lambda_2, ..., \lambda_n} = \sup(\lambda_1, \lambda_2, .., \lambda_n) - \inf(\lambda_1, \lambda_2, .., \lambda_n)$
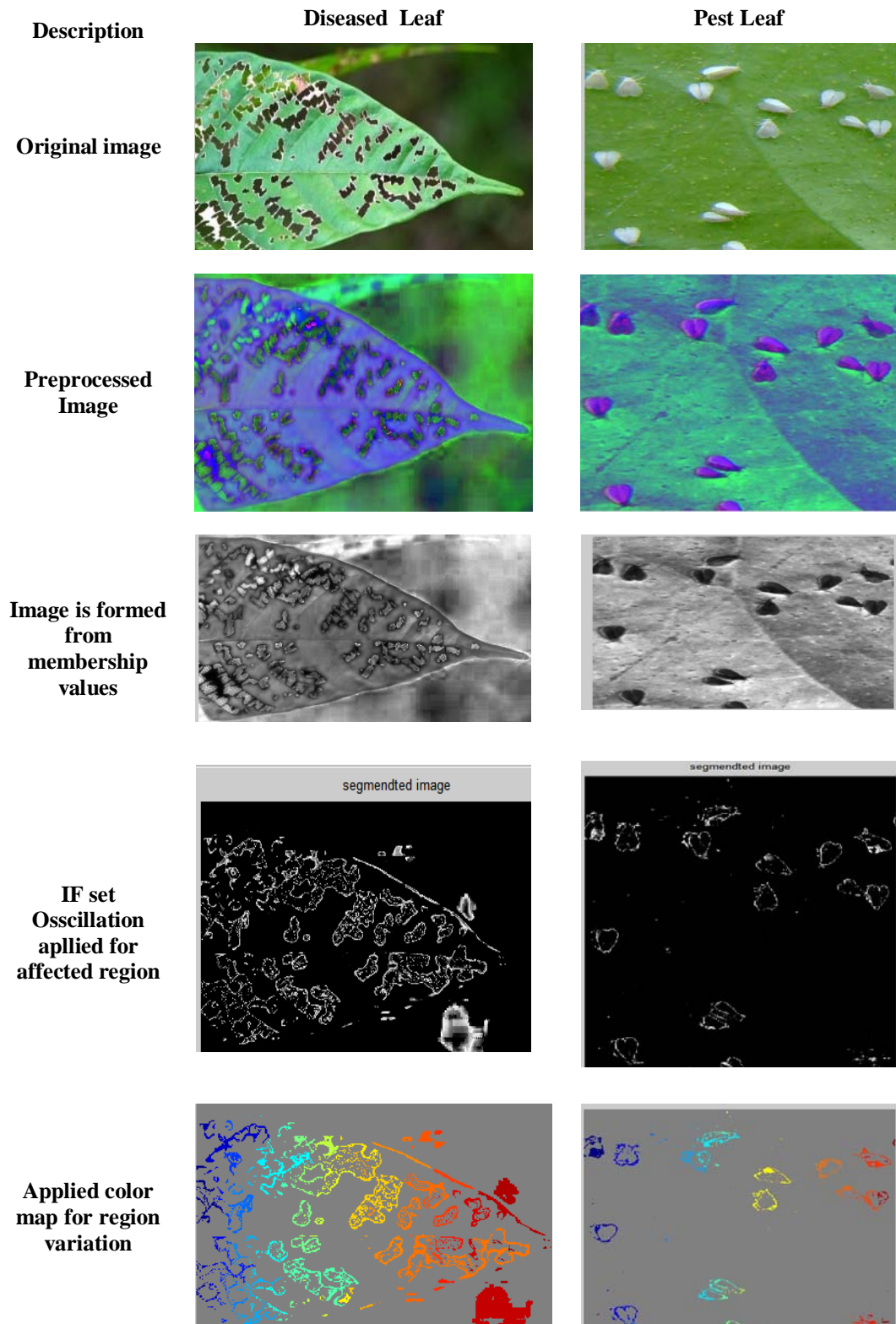
D) Calculated the infected Region

Pest and disease region was calculated through after segmented the object from the image. The calculated the affected region is compared with existing method of iterative threshold and proposed technique IF Set Oscillation based segmentation shows on Table 1.

Table-1: Affected region for proposed technique and existing technique

| S. No	Image description	Methods	Affected area (%)	Over / correctly segmented
1	Pest leaf-Image1	IF set oscillation	15.0463	Correctly segment
2	Pest leaf-Image 2	Iterative threshold	5.034	Over segment
3	Diseased leaf- Image 3	IF set oscillation	20.043	Correctly segment
4	Diseased leaf-image 4	Iterative threshold	3.042	Over segment

4. EXPRIMENTAL RESULT

The proposed methodolgies were implemented with MATLAB 2009b, on dataset of digitized pest and diseased infected leaf images. PC with 2.3 GHz, Intel Core i3 processor, 2 GB RAM and Windows 7 platform. The results shown on Figure2.

Description	Diseased Leaf	Pest Leaf
Original image		
Preprocessed Image		
Image is formed from membership values		
IF set Osscillation apllied for affected region		
Applied color map for region variation		

Figure-2: Results for IF set oscillation based segmentation was applied to segement the affected region on various leaf images.

The existing method of iterative threshold is applied to the pest and diseased leaf images. This algotihm was oversegemented the region. It was detected with nosiy. This expreimental result shown on figure3.

Image Dataset	Original image	Applied existing method
Pest leaf		
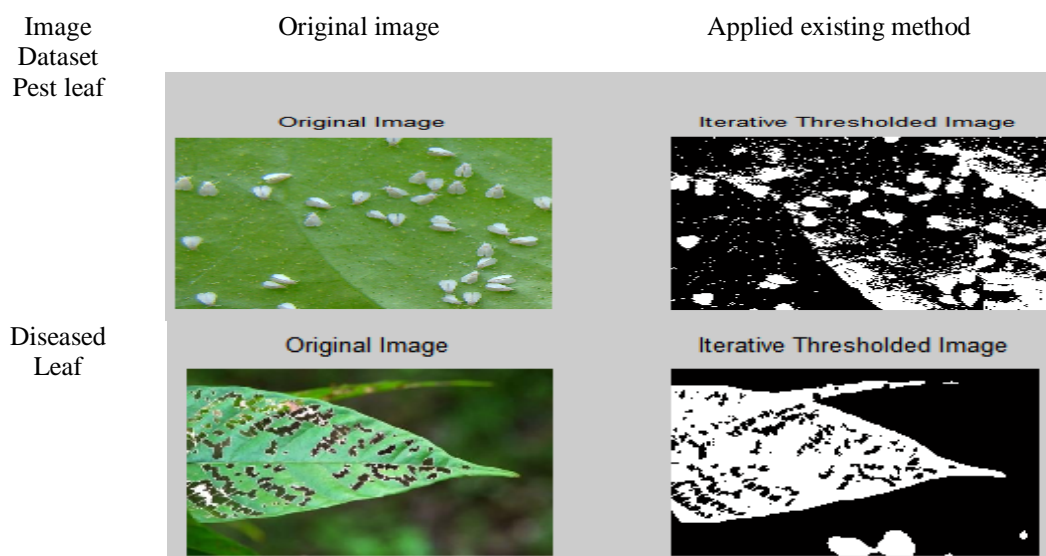
Figure-3: Existing method is applied for Image Dataset

5. CONCLUSIONS

Agricultural is important of human survival. Nowadays human population is rapidly increasing, so must enhance the agricultural growth too. But, productivity of agricultural crops, vegetables and fruits are reduces by some kind of reason such as disease and pest affected the crops and trees. Early detection of disease and pest infection helps to improve the agricultural growth and reduce the economic loss by using computer Aided techniques. These techniques are very useful to analyze digital image of agricultural diseased and pest affected leaves. Manually monitored the green house is very time consuming process. The proposed technique of If set oscillation based segmentation produce better result and overcome the over segmentation compare to the existing method of iterative threshold. From this method detected the diseased and pest affected region properly. From this kind of research technique is helps to improve the economical level and reduced the usage of pesticides.

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