Rice plant disease detection and classification using computer vision technology and fuzzy logic

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Abstract

*Rice is one of the essential crops in India and losses due to diseases badly affect the economy and farmers. Automatic detection and monitoring is very essential for precision agriculture It may achieved with the help of image processing techniques .This work presents an approach for disease classification on paddy leaves that makes use of Fuzzy Inference System(FIS) .Two diseases namely bacterial blight and brown spot have been identified and classified .The color feature of an leaf image have been extracted by L*a*b color space and from the extracted feature brown spots and blight portions were segmented with the help of color thresholding. Then the proposed agri-leaf spot Fuzzy model have been used for disease classification on given leaf image.*

Keywords: *We would like to encourage you to list your keywords in this section*

Keywords— Rice Plant leaf disease classification; Fuzzy Inference System; L*a*b; Paddy Diseases

1. Introduction

India is a land of small farmers, today our farmers facing so many challenges on their cultivation because of unconditional weather and high population, the food production need is high but the farm land is lesser than our needings.so farmers are having the pressure of increasing their yield with few acres, due to this they use chemical pesticides in huge amount on their crop this may cause very serious problem on people health .These problems could be overcome by "smart farming".

In this work we used rice plant images as a input to classify diseases because rice is a primary food source of India. Rice may lose its quantity and quality when rice plant is attacked by different disease. Therefore, it is a top priority to find effective methods to reduce the level of their infestation in the paddy fields. Leaves are the best health indicator of a plant so we use the green intensity values and the number of brown spots as a parameters to identify the diseases on rice crop.

2. Literature review

In Past few years the image processing techniques widely used for agriculture in various problems like disease classification, weed management, fruit garding, pest identification**.**

Xuebing Bai e.t al(2017)[9] segmented a cucumber leaf spot from its complex background by using fuzzy clustering based neighborhood segmentation with high accuracy.

K. Muthukannan and Dr. P. latha classified a unhealthy and healthy portion of a tomato leaves using fuzzy inference system with 95% of accuracy

R. Pydipati et. al identified diseases on citrus fruits using color feature segmentation,they use various color features and CCM with the accuracy rate of 96.3%

Libo Liu, Guomin Zho,Extracted rice leaf disease using back probagation neural network model with high accuracy.

3. Proposed Methodolgy

In this work images were collected from internet dark spot diseased images and healthy leaf images were used. Those images had various size and formats that are resized and used for further process.

Image Preprocessing

The images were collected from the internet were resized into [300x 300] size uniformly to increase the performance of algorithm and reduce the complexity. In many agriculture research papers they suggested the above mentioned size.

Color Feature Extraction

Color is perceived by humans as a combination of tristimuli *R* (red), *G* (green), and *B* (blue) which are usually called three primary colors. From *R,G, B* representation, we can derive other kinds of color representations (spaces) by using either linear or nonlinear transformations. Several color spaces, such as *RGB, HSI,CIE ¸*u*v** are utilized in color image segmentation, but none of them can dominate the others for all kinds of color images. Selecting the best color space still is one of the difficulties in color image segmentation [1].

*L*a*b*

This color space is originally defined by CAE and specified by the International Commission on Illumination In this color space, we have one channel is for Luminance (Lightness) and other two color channels are a and b known as chromaticity layers[1]. The a* layer indicates where the color falls along the red green axis, and b* layer indicates where the color falls along the blue-yellow axis. a* negative values indicate green while positive values indicate magenta; and b* negative values indicate blue and positive values indicate yellow.[11].

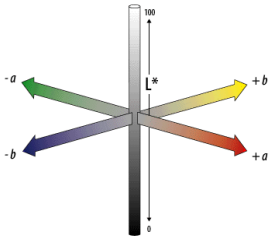

Figure 1:Color spaces on MATLAB

5. Color Thresholding

On the selected L*a*b space the channel second (a) has red and green intensity values .so it is selected for segmenting brown spots because leaves are green dominant, spots may have a combination of red and green intensity. On color histogram of *a space minimum and maximum value stetted for separating brown spots

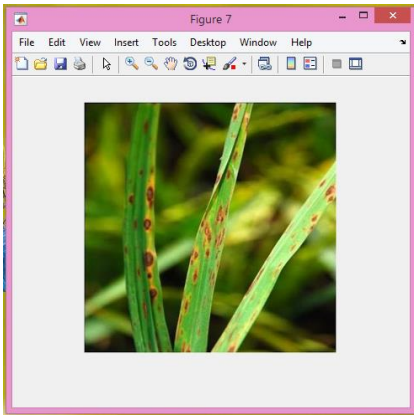

Figure 2:Brown spot disease image

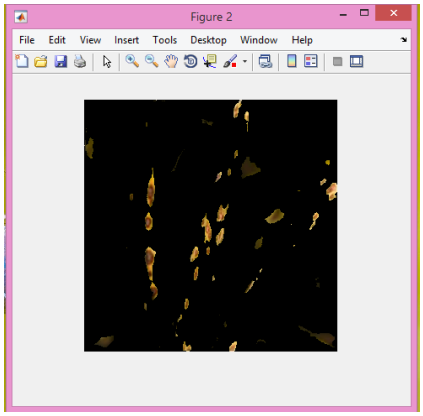

Figure 3:Segmented image

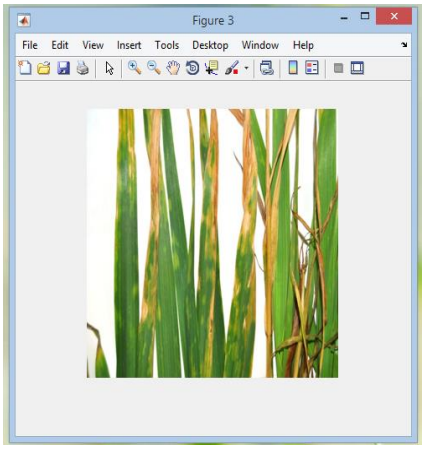

Figure 4:Bacterail blight disease image

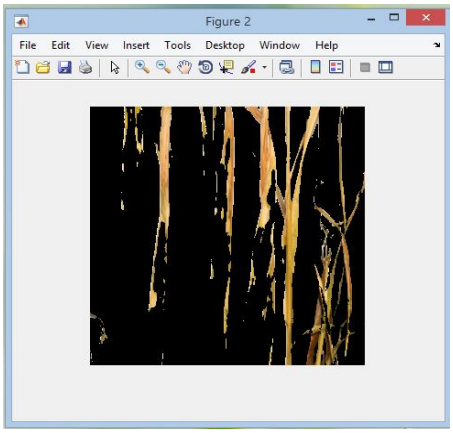

Figure 5:Segmented image

6. Fuzzy Inference System

The general operation of the fuzzy system is performed based on the following process.on MATLAB FIS editor supported for building fuzzy model.

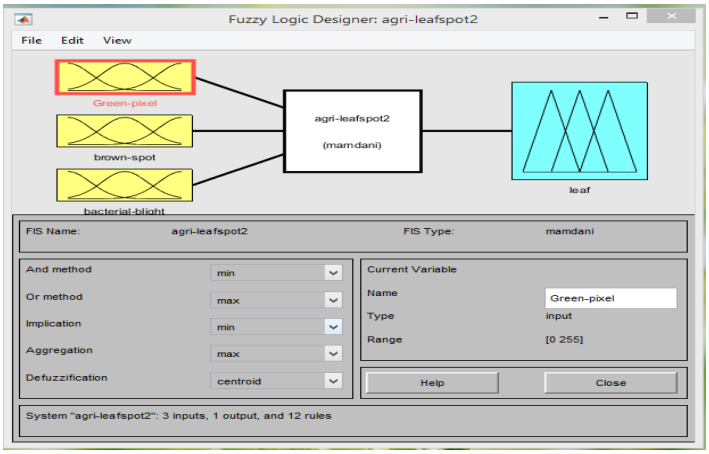

Figure 6:Fuzzy model-agri leafspot

Fuzzification

The process that allows converting a numeric value (or crisp value) into a fuzzy input is called fuzzification. There are two ways to do fuzzification:where there is no noise. Triangular membership function was used to fuzzify input and output functions.

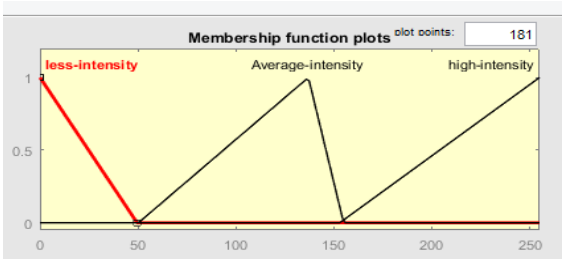

Figure 7:Membership values of Green intensity input

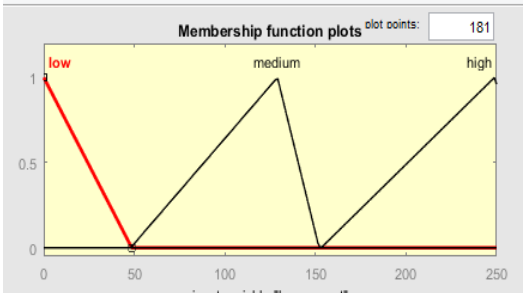

Figure 8:Membership values of Brown spots

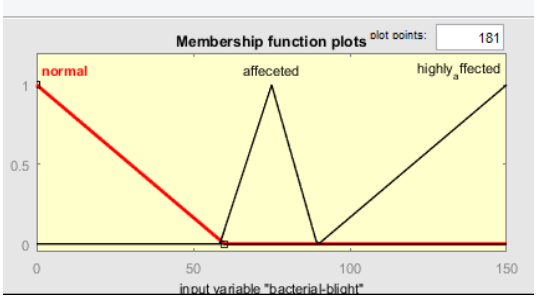

Figure 9:Membership values of Bacterial blight input

In this work the paddy leaves were fuzzified into five categories 1.Healthy leaf 2.Affected Brown spot and 3.Highly affected brown spot 4.Affected Bacterial blight 5.Highly affected bacterial blight for this fuzzification green intensity values, no of spots and blight area intensity values are used as decision parameters.

Fuzzy Rules

Fuzzy If-Then Rules Fuzzy sets and fuzzy sets operations are the subjects and verbs of fuzzy logic [8]. If-Then rule statements are used to formulate the conditional statements that comprise fuzzy logic.A single fuzzy If-Then rule assumes the form.

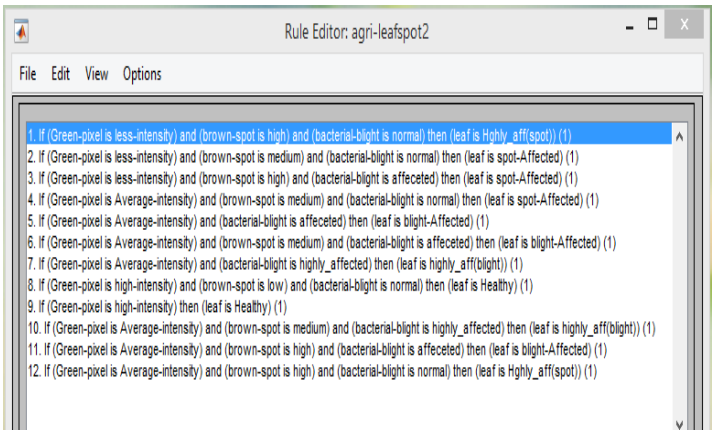

Figure 10:Fuzzy rules for agri-leaf spot identification

c) *Defuzzification*

Defuzzification is the reverse process of fuzzification.Mathematically, the defuzzification of a fuzzy set is the process of conversion of a fuzzy quantity into a crisp valuei.e. rounding off from its location in the unit hypercube to the nearest vertex. This may be necessary if we wish to output a number to the user.Centroid method is used for deffuzification.

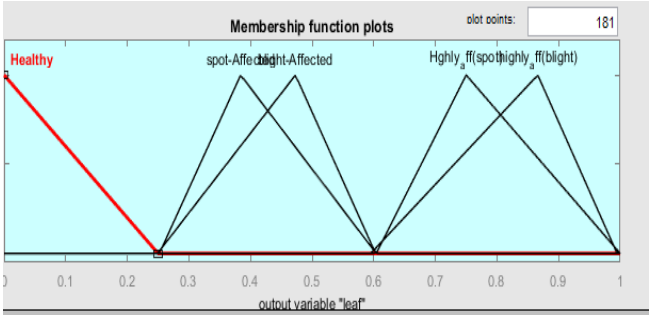

Figure11:Membership values of leaf output

4. Results

We develop agri leaf spot fuzzy model (mamdani) with two input variables namely green pixel and brown spots for input and output functions triangular membership function was used. Green pixel intensity of healthy images will be high but affected leaf green intensity will be lesser because affected portions dominated by red intensity.

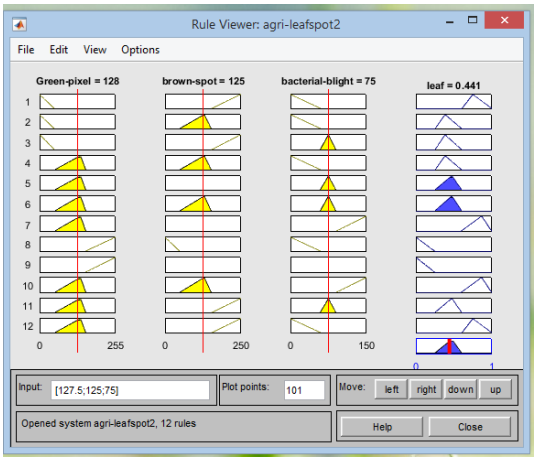

Figure 12: Healthy leaf Result

Above Result green pixel range is 116 and no of spots is 55.7 then the leaf categorized as affected. and the crisp output value is 0.5.

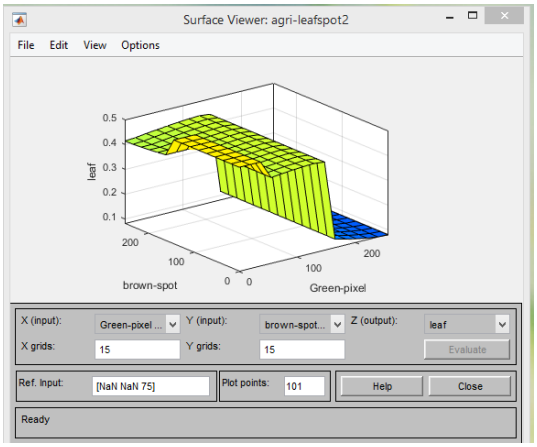

Figure 13:Results of Healthy and Affected leaves

5. Conclusion

The main contribution of this paper proposed an approach fuzzy rule-based system using color features for the classification disease affected plant leaf image region. The proposed method FIS using color features were clearly classified the region such as healthy, slightly affected disease portion and highly affected disease portion of the plant leaf image Classifying the unhealthy region is the main purpose of the proposed approach. The experimental results indicate the proposed approach can detect the leaf diseases region with little computational effort. The extension of this work will focus on developing methodology for better segmentation and classification using neuro-fuzzy system.

6. References

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