Groundnut leaf spot disease identification and classification using Fuzzy inference system

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Abstract—**Due to increasing demand in agriculture and Economy, farmers are need to increase their productivity of crops at the same time they also earn more profit in their cultivation. This is very difficult for small farmers because there are so many challenges for farmers like canopy, water management, weed control, weather conditions, field conditions and less rainfall. This may be achieved by precision agriculture. In this paper we proposed a fuzzy inference system based classification for early disease identification, and we used image processing techniques as an automatic tool which will help to reduce the communication gap between the small farmers and agriculture officers. In the proposed system we identify the disease on groundnut plant leaf images using L*a*b color feature based segmentation. The segmented images were classified into healthy, affected and highly affected classes with the help of Fuzzy Inference system.**

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

I. 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 groundnut leaf images as a input to classify diseases because peanut is a primary oil crop in south India. Groundnut may lose its quantity and quality when 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 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 groundnut crop.

II. LITERATURE REVIEW

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

Xuebing Bai e.t al(2017) 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.

III. PROPOSED METHODOLGY

In this work more than 100 images were used for classification these 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.

A. 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.

B. 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].

1.RGB

Red, green, and blue components can be represented by the brightness values of the scene obtained through three separate fillters (red, green, and blue fillters) based on the following equations[1].

$$R = \int_{\lambda} E(\lambda) S_R(\lambda)\, d\lambda,$$

$$G = \int_{\lambda} E(\lambda) S_G(\lambda)\, d\lambda,$$

$$B = \int_{\lambda} E(\lambda) S_B(\lambda)\, d\lambda,$$

2.HSV

HSV is an another color space which represented as cylindrical geometry with hue, their angular dimension, starting at the red primary at 0°, passing through the green primary at 120° and the blue primary at 240°, and then wrapping back to red at 360°. [11]

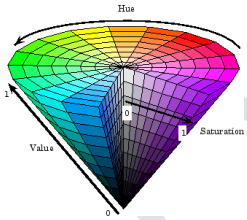

Figure-1 HSV

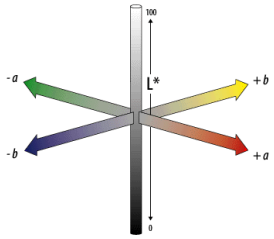

*Figure 2:L*a*b*

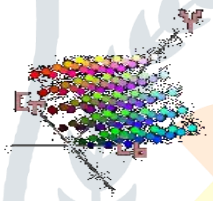

Figure 3:Ycbcr

*3.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].

4.Ycbcr

The YCbCr color space is widely used for digital video. In this format, luminance information is stored as a single component (Y), and chrominance information is stored as two color-difference components (Cb and Cr). Cb represents the difference between the blue component and a reference value. Cr represents the difference between the red component and a reference value.

In this work RGB Groundnut leaf images were converted into the above referenced color spaces with the help of MATLAB16 from those color spaces L*a*b color space chosen for color thresholding

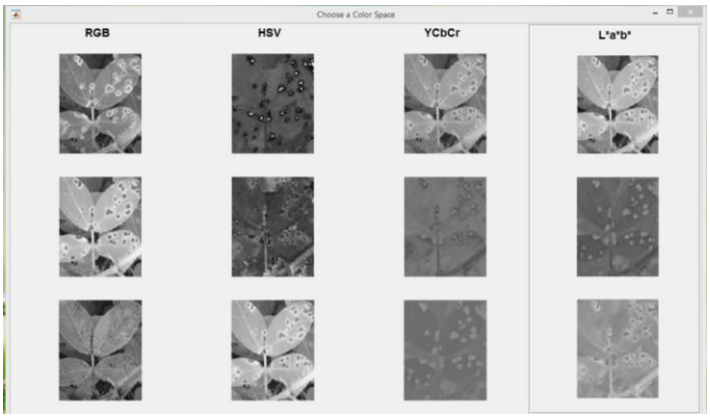

Figure 4:Color spaces on MATLAB

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

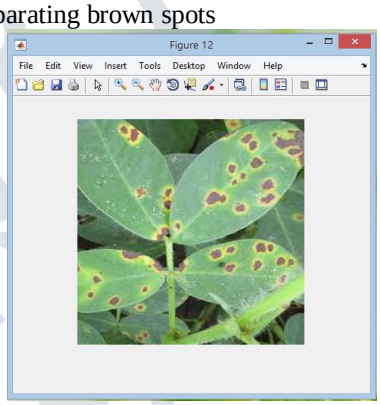

Figure 5:Brown spot disease image

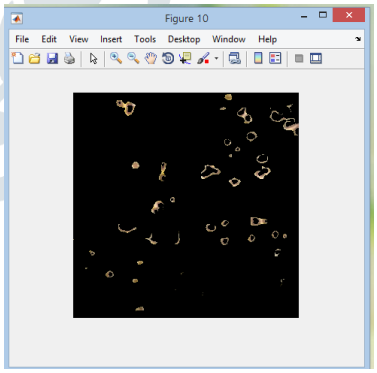

Figure 6: Segmented image

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.

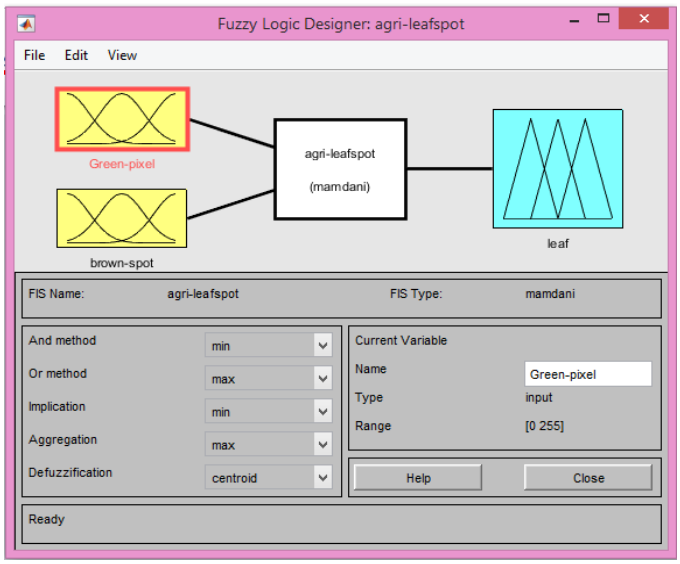

Figure 7:Fuzzy model-agri leaf spot

a) 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.

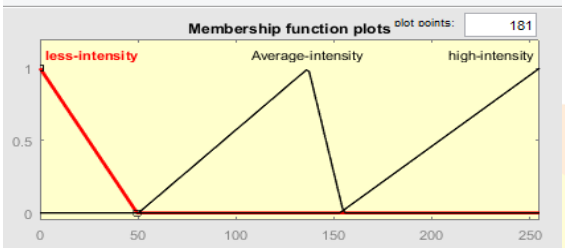

Figure 8:Membership values of Green intensity input

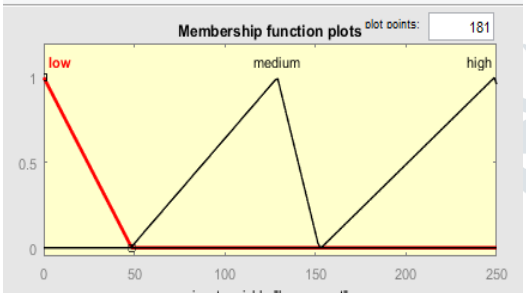

Figure 9:Membership values of Brown spots input

In this work the groundnut leaf were fuzzified into three categories 1.Healthy leaf 2.Affected leaf and 3.Highly affected leaf for this fuzzification green intensity values and no of spots are used as decision parameter The .Mean value of healthy green leaf and affected leaf were calculated. Brown spot labels of normal and highly affected leaf images also Counted.

b) 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.

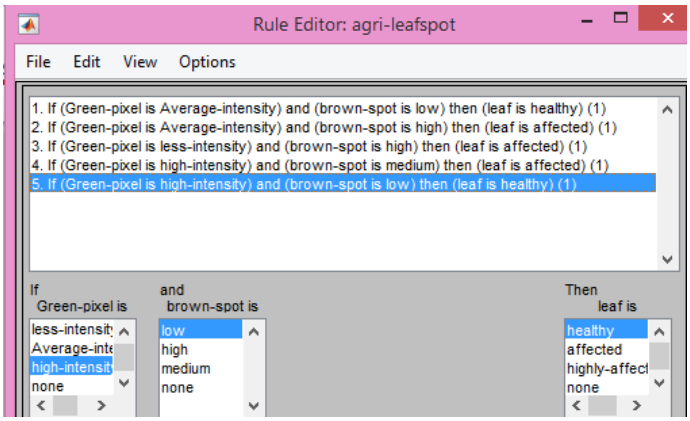

Figure 10:Fuzzy rules for agri-leaf spot identification

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.

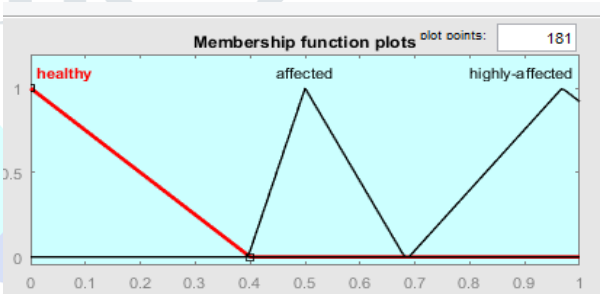

Figure 11:Membership values of leaf output

IV 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.

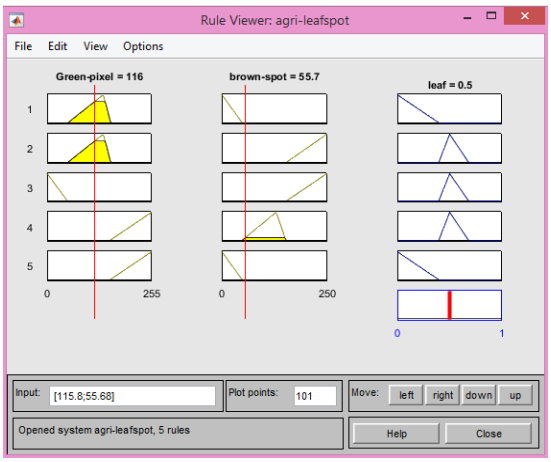

Figure 12: Affected leaf Result

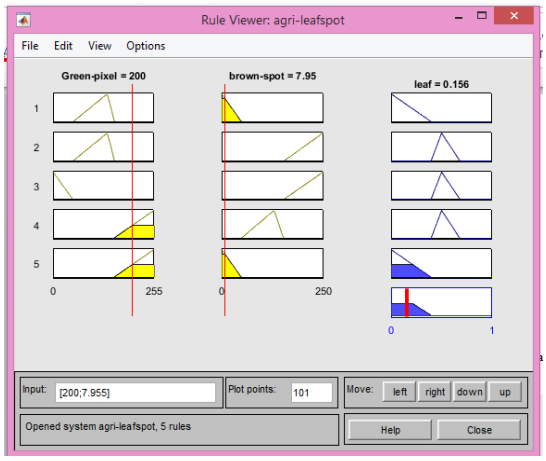

Figure 13: Healthy leaf Result

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.

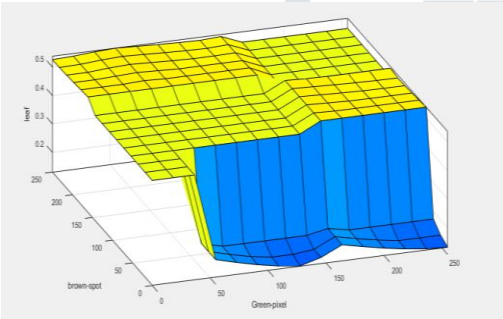

Figure 14:Results of Healthy and Affected leaves

IV. CONCLUSION

The main contribution of this paper was 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.

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