International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05, 2020
ISSN: 1475-7192

Smart Farming Using Artificial Immune System Algorithm and Image Processing

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Abstract--- *For any Developing country like India Agriculture plays an important role and Contribute major part of income to the country, so there is a need to grow and increase the yield effectively. In order to achieve above objectives one has to monitor on the diseases stating from plantation to harvesting. In this paper we made an attempt to use Artificial Immune System(AIS) and image processing to (i) Identify the diseases on fruits like Grapes and Apple (ii) Grading of fruits. Disease identification aims different features like color, texture and shapes. Which are considered as feature vectors in this work. To extract color feature HSV histogram value concept is used, for texture wavelet transform method and for shape morphology methods are used. After extracting the above said features we used AIS algorithm as a classifier to classify the diseases and it is observed that the color and morphology shows better results than texture. Grading of fruit aims fruit segmentation which calculates healthy and infected portion of fruit. At the end we practically implemented AIS algorithm and results are obtained from MATLAB.*

Keywords--- *Smart Farming, Artificial Immune System, Image Processing and Fruit Grading*.

I. INTRODUCTION

Smart-farming acts as a decision tool to formers to supervise the crops and identify the diseases of crops in early stages and helps in better productivity and gives profit. The well known method used to identify diseases in fruits is image processing technology as the visual observable patterns helps in detection of diseases. These technologies also help in increasing the production and hence reducing the usage of natural resources.

The problems stated in this article are, supervising diseases on grapes and an apple secondly suggesting better solutions for good productivity. AIS algorithm is proposed for the aforementioned problem. For training of AIS a data base consisting of set of images of diseased fruits have been generated. For generating features of all images, the feature vectors namely color-morphology-texture are used. [2] The mapping between query image and trained images is done by Euclidean distance concept. At the end it is concluded that the feature vector morphology gives excellent result compare to color and texture because morphology uses high frequency boundary information.

The Objectives considered in this article includes;

(i) Supervise diseases on grapes and an apple.

(ii) Propose solutions to get better productivity.

Name of the two diseases considered here are namely, Grapes - Black Rot and Apple - Apple Rot.

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DOI: 10.37200/IJPR/V24I5/PR2020673
Received: 16 Apr 2020 | Revised: 22 Apr 2020 | Accepted: 12 May 2020

Fig. 1(a): Black Rot

Fig. 1(b): Apple Rot

Role of Image Processing in Smart Forming

- To identify diseased fruit, stem and leaf.
- Spreading of disease.
- Computing weight of fruits.

II. METHODOLOGY

The feature vectors namely color-morphology-texture are worn to extract images for learning data base.

Color: One of the important feature that human uses for object discrimination. The principle of color image processing consists of namely (i) Color mapping (ii) Individual color planes processing (iii) Color vector processing. Here, [8] HSI color space is used to capture the image.

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RGB to HIS color Transform:

$$H = \begin{cases} \delta & if\ D < J \\ 360 - \delta & if\ D > J \end{cases}$$

Where,

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$$\delta = cos^{-1}\left\{\frac{\frac{1}{2}(P-J)+(P-D)}{[(P-J)^2+(P-D)(J-D)]\frac{1}{2}}\right\}$$

Morphology: Act as a tool for generating disease-shape feature vector from good fruit and useful in representing and describing boundaries. Here, for all images boundaries are obtained by the concept called Erosion given by the following equation,

$$Erosion = \{Y/(M)y \subseteq N\}$$

Boundary image = original image – eroded image

Here, N = data base images

M = input image (set of all points Y)

Texture: This feature vector describes visual patterns, with the property of homogeneity. 2-D wavelet decomposition [5] is used, which is represented by the equation given below,

$$\varphi^{ab}(x) = |a|^{\left(\frac{-1}{2}\right)}\varphi\left(x-\frac{b}{a}\right)$$

$$E_\varphi = \frac{1}{\sqrt{a}}\int_{-\infty}^{\infty} f(t)\varphi\left(t-\frac{b}{a}\right)dt$$

$$\varphi(x) = mother\ wavelet$$

$$\varphi^{ab}(x) = daughter\ wavelet$$

Role of Artificial Immune Algorithm in image classification

After extraction of feature vectors, images of learning data base are classified by implementing AIS. These vectors are considered as Antigens in AIS and outputs are considered as Antibodies. After calculating the learning data base weight AIS going to examine for uncertain image which is not previously in data base learning. Fig.3 represents the working principle of AIS.

Automated Grading of Fruits

The method here used to grading of fruit is spread of disease which is done by K- clustering.

$$Percentage(\%)of\ infection\ = \left(\frac{T_d}{T_p}\right) * 100$$

$where, T_d = Total\ number\ of\ pixels\ in\ disease\ region$

$$T_p\ = Total\ number\ of\ pixels$$

III. RESULTS AND DISCUSSION

More than 50 images are considered for learning purpose. Learning is a process which classifies the images into different categories. This has been achieved using AIS-toolbox in MATLAB. Various metrics are available to grade the performance of AIS. Here, we used mean square error method. For finding disease spread we used fuzzy method. The steps used in order to find spread of disease are image acquisition, image processing and color-image segmentation. Depending on infection of disease grading is done and shown in the table 1.

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Table Type Styles

Percentage of Infection	*Disease Grade*
upto 1	0
1-10	1
10-20	2
20-40	3

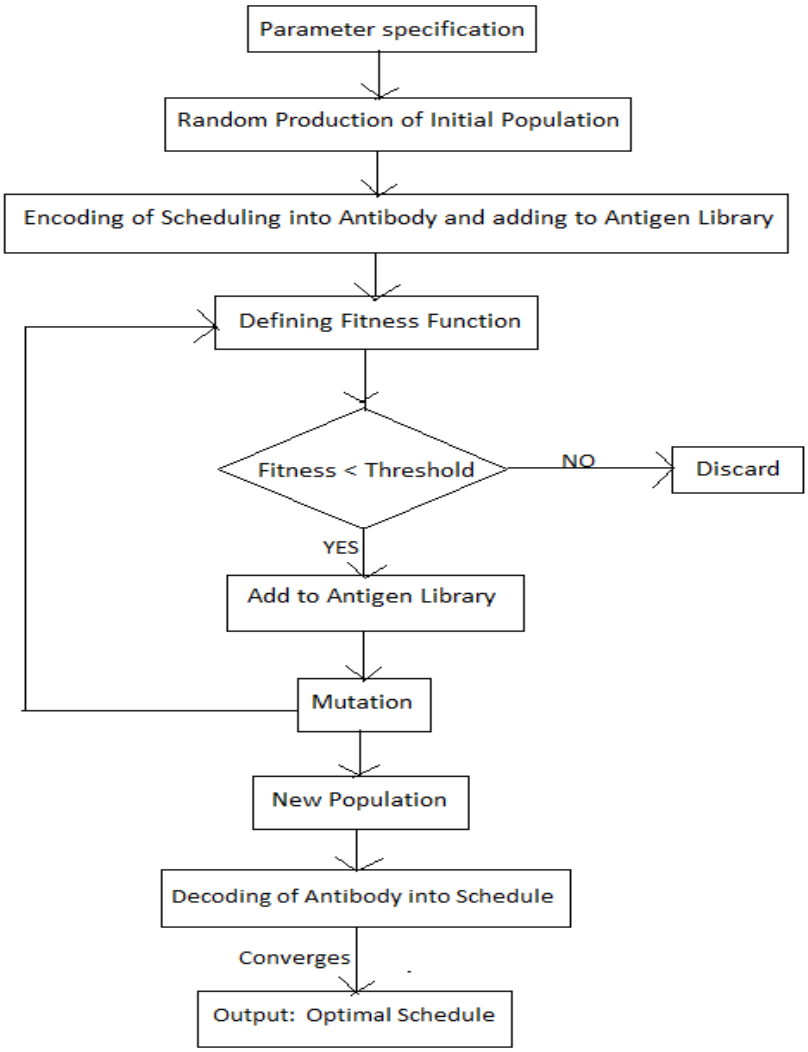

Fig. 2: Flow Chart of AIS

IV. CONCLUSION

Based on the Experimental results the developed AIS algorithm can identify and classify the tested diseases and also it is noted that color and morphology gives better results compare to texture. Using image processing a spread of disease by grading of fruit has been achieved. Formers will get benefitted with this grading method to know how much fertilizer to be applied. These works will help Indian formers to do smart-forming and to take decisions periodically for a good yield. Future work is to have a fruitful conversation with agricultural bodies and help them in agriculture.

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ACKNOWLEDGMENT

The author is grateful to the management of New Horizon College of Engineering led by its Chairman, Deans and Principal for their support and guidance.

REFERENCES

[1] Sindhuja sankarana, Ashish Mishra et.al, "A Review of advanced techniques for detecting plant diseases in computers and Electronics in Agriculture", vol 72, pp 7-13, 2010.

[2] Murugesan.R, et. al., "Optimization of Image Enhancement using an Artificial Immune System Algorithm", *IJMET,* vol.8, pp 184-192, 2017.

[3] Alexandre Meybeck and Vincent Gitz, "leaf diseases severity measurement uses image processing in Agriculture", *food security conference.* 2012.

[4] K.P Soman and K.L Ramachandran, "Insight into Wave let transform theory to practice", 2nd *edition, PHI publications,* 2009.

[5] Sanjeev S Sannakki, Vijay S Rajpurohit, V B Nargund, Arun Kumar R, Prema S Yallur, "Leaf Disease Grading by Machine Vision and Fuzzy Logic", *International Journal of Computer and Technology Association,* vol 2 , pp 1709-1716, Oct 2011.

[6] N. Papamarkos, C. Strouthopool, I. Andreadis, "Multi thresholding of color and gray level images through a neural network technique", *Image and Vision Computing, Elseveir,* vol.18 ,pp. 213-222, 2000.

[7] Boaz Lerner, Hugo Guterman, Mayer Aladjem, "Al network based feature extraction comparative study of neural paradigms", *Pattern Recognition letters,* vol.20, pp. 7-14, 1999.

[8] Rafael C. Gonzalez and Richard, E. Woods, "Digital Image Processing using MATLAB", 3rd *edition, Pearson publications,* 2009.

[9] Suma T and Murugesan R, "Subtask Scheduling of Industrial Robot in Cloud Manufacturing using Artificial Immune Algorithm", *Journal of Physics: Conference Series* Vol 1000**,** pp 1-7 Feb 2018.

[10] B Monika Jhuria, Ashwani Kumar, Rushikes Borse, "Image Processing for Smart Farming: Detection of Disease and Fruit Grading", *IEEE Second International Conference on Image Processing,* vol 9, pp. 521 - 526, Dec. 2013.

[11] Xu Liming and Zhao Yancho, "Automatic Strawberry grading system based on image processing" *Computers and Electronics in Agriculture,* vol 71,pp s32-s39, April 2010.

[12] Haiwei Dong, Nikolaos Mavridis and Abdulhamid Haidar, "Image-Based Date Fruit Classification", *International Congress on Ultra Modern Telecommunications and Control Systems,* vol. IV, 2012.

[13] Saravanan, S., SS Aravinth, and M. Rameshkumar. "A Novel Approach in Agriculture Automation for Sugarcane Farming by Human Assisting Care Robot." *International Journal of Agricultural Science and Research (IJASR)* 7.4 (2017):107-112

[14] Shireesha, K., et al. "Correlates of Profile and Attitude of Youth towards Farming." *International Journal of Agricultural Science and Research (IJASR)* 7.1 (2016):43-52

[15] Barusu, Madhusudhana Reddy, et al. "Irrigation, Fertilizing and Weed Cutting in the Row Crops with IOT Controlled Robot." *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)* 8, Special Issue 3 (2018):512-518.

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