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Early Detection of Disease in Bittergourd Leafs at Germination stage

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Abstract
Early detection of Alternaria Blight disease in bittergourd leaf is possible by applying image processing techniques. Growth of the plant is categorized into five stages. Separate images are taken for healthy, diseased and test leafs. The images and color characteristics of the leafs are analysed using RGB, HSI and HSV models and disease is detected early by comparing the values of healthy and diseased leafs with test leafs.

Keyword: RGB, HSI, HSV, Germination

Introduction
Bitter gourd is a widely popular cucurbitaceous vegetable grown extensively in several parts of India. It is grown in all types of soil. The seeds are sown in the months between January to March or September to December. The seeds are soaked in water for upto 24 hours and sown two or three seeds together in pits that are one inch deep. The seeds usually germinate in 2 to 3days. The germinated seeds are later replanted avoiding damage to the root system on raised beds 60cm diameter apart. Growth of the plant is divided into five stages, which are germination, branching, flowering, fruiting and seedling(mature)[1]. The plant usually grows up to 6 feet in height and has a hairy stem with numerous branches and dense foliage. The plants should be watered regularly. Flowers usually appear in 5 to 6 weeks and fruition usually occurs between 2 to 4 months. Male flowers that do not develop into fruits and female flowers that do, grow on the same plant[2][4] [6]. Production requires a trellis to provide support for the climbing vine. The trellis should be 6 feet high, 4-6 feet apart.
Pride of Gujarat, Phule Ujawala, Phule Priyanka, Coimbatore Long, Priya, Preethi, Phule Green Gold, Pusa Do Mausmi, Priyanka and Arka Harit are the main varieties of bittergourd grown in India[2][4][6][9]. Of these Priyanka is the most widely cultivated variety in south Kerala as shown in figure1. The fruit in this variety is narrower with pointed ends, hollow cross section and surface covered with jagged triangle teeth and ridges. The fruit is best eaten as it begins to turn yellow as at this stage it is watery and crunchy in texture but it becomes more bitter as it ripens[10]. The fruit is rich in vitamins B1, B2 and B3, C, folate, magnesium, phosphorus, manganese, zinc and has a high dietary fiber [4][6]. It contains twice the calcium of spinach, twice the beta-carotene of broccoli, twice the potass-ium of a banana and is also rich source of iron. Hchyp-oglycemic compound in bittergourd is beneficial in lowering sugar in blood and urine. The juice is very beneficial to treat disorders like boils and itching. Significant improve-ment in glucose tolerance has been reported with bittergourd juice without increasing blood insulin level. Regular intake of its juice has shown to improve stamina level, energy and also sleeping patterns. Bittergourd juice also acts as a detoxifying agent and helps clean up toxic blood and improve blood circulation. It helps cleansing and repair liver problem due to alcoholism [11]. This bitter juice builds up a strong immune system. Regular intake of bitter-gourd juice has shown to be beneficial in dermatological conditions like psoriasis, ring worm infection, athletes feet. As the fruit is very rich in beta carotene it improves eyesight and alleviates eye problems.
Manuring is essential factor for the healthy growth of bittergourd. Apply FYM at 20-25 t/ha-^{1} as basal dose along with half dose of (35kg) N(Nitrogen) and full doses of 25kg of K_2O(Potassium oxide) and 25kg P_2O_5(Phosphorus pentoxide). The remaining dose of 35kg N(Nitrogen) can be applied in several split doses at fortnightly intervals[2].
The purpose of this paper is to demonstrate a novel way to identify Alternaria Blight disease of bitter gourd leafs in its early stages. The traditional way to identify the disease is by visual examination but this research aims to identify the disease before it is visually obvious. Early and accurate identification will help the farmer to limit the damage and prevent the spread of disease. Treatment is of little use after the disease has reached advanced stages.

Problem statement
Fusarium wilt, Collar rot, Powdery mildew, Downy mildew,

Alternaria blight, Anthracnose and Mosaic are the main diseases that attack the bitter gourd plant at various stages[4][5][6]. Alternaria blight is more commonly seen in the southern part of India. This disease produces concentric rings that start from the margins of the leafs. Yellow spots appear on leafs which turn brown and finally black on aging [5]. The disease can affect the upper, lower or both surfaces of the leafs as shown in figures 2 and 3.

Fig 1. Priyanka variety Bitter gourd

Fig2. Front side of Diseased leaf

Fig 3. Back side of Diseased leaf

The methods described in this paper will help detect this disease in its early stages by making use of advances in technology and biotechnology. This requires minimum processing time, no special training and has been shown to be more accurate compared to traditional ways.

Material and Methods

Private and Government farms are selected for identifying healthy and diseased plants. Sunny days were preferred for acquiring image. Nikon 20 mega pixel digital camera at 640*480 resolution was used for capturing image. In order to maintain a uniform back ground white board was kept behind the leafs. Images of front and backside of leafs are taken for healthy, diseased and test leafs. The images were then analyzed using Image processing tool in MATLAB 2012.

A. RGB Model

The color characteristic of bitter gourd leafs is analyzed using RGB color model, the three primary color red, green and blue form the axis of the cube. The secondary color magenta, cyan and yellow are at three other corners as shown in figure 4. The Alternaria Blight disease leafs is detected by the variation of the color intensity[3]. Germination stages Diseased, Healthy and Test leafs are taken for analysis. RGB can be carried out through the following formula[1][3][6][7][8][12][13][15][17][18].

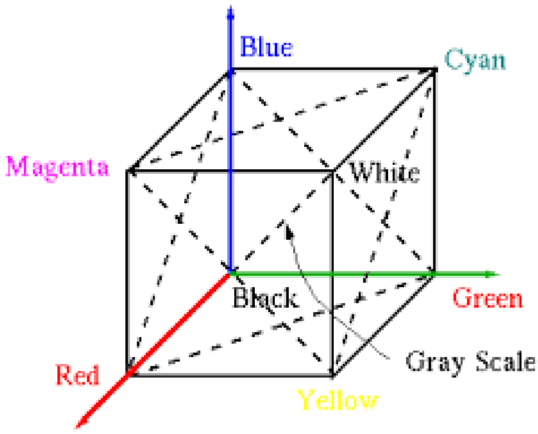

Figure 4. RGB color cube

If X+Y+Z=1,
X(red), Y(green), and Z(blue)
X=1-(Y+Z) (1),
Y=1-(X+Z) (2),
Z=1-(X+Y) (3).

B. HSI

HSI stands for Hue, Saturation and Intensity. Hue represents dominant color as perceived by an observer. It is an attribute associated with the dominant wavelength. Saturation refers to the relative purity, the amount of white light mixed with a hue. Intensity reflects the brightness. HSI decouples the intensity information from the color, while hue and saturation correspond to human perception, thus making useful for developing image processing algorithms as shown in figure 5. The RGB to HSI can be carried out through the following formula[1][3][6][14][16][19][20].

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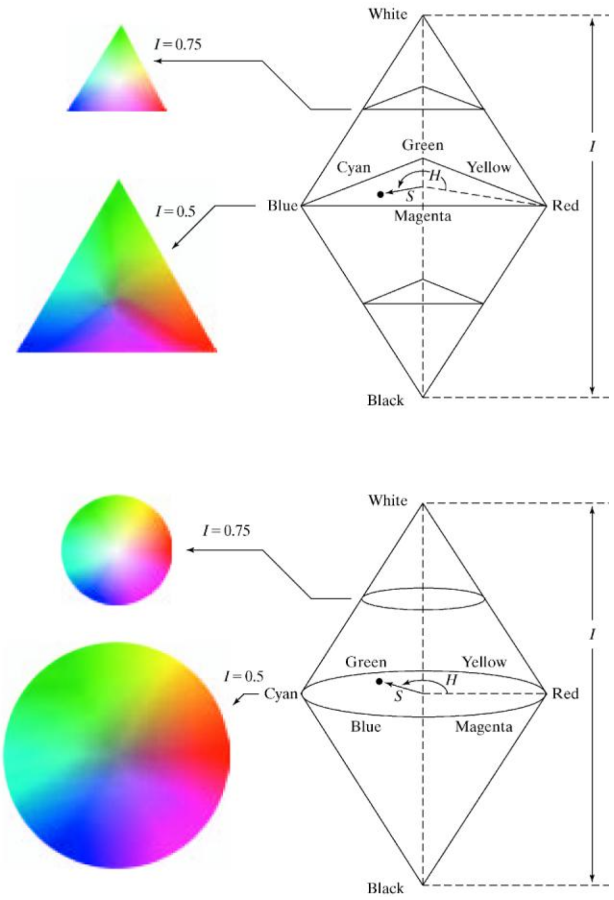

Figure 5. HSI color model

$$I = \frac{1}{3}(R+G+B) \quad (1)$$

$$S = 1 - \frac{3}{(R+G+B)} * a \quad (2)$$

Where 'a' is the minimum of R, G and B

$$H = \cos^{-1}\left\{ \frac{0.5*[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{0.5}} \right\} \quad (3)$$

If S=0, H is meaningless

If (B / I)>(G / I) then H= 360-H. Since H is an angle in degree then normalise to 0, 1 with H=H / 360.

C. HSV

HSV stands for Hue, Saturation and Value. The model is based on polar coordinates[6][19]. To convert from RGB to HSV find the maximum and minimum value from the RGB triplet as shown in figure 6. The RGB to HSV can be carried out thr-ough the following formula.

Saturation s then $S = \frac{(\max - \min)}{\max}$ (1)

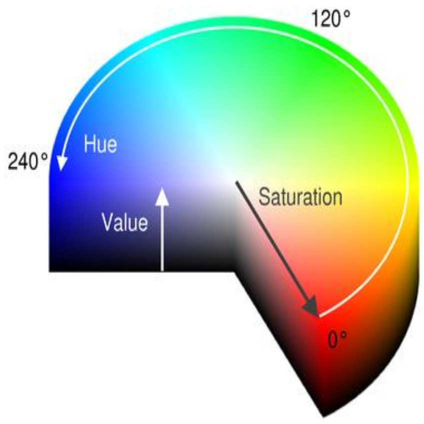

Figure 6. HSV color model

value 'V' is V = max (2)

Hue, H is then calculated as follows first calculate R' G' B'

$$R^1 = \frac{\max - R}{\max - \min} \quad (3)$$

$$G^1 = \frac{\max - G}{\max - \min} \quad (4)$$

$$B^1 = \frac{\max - B}{\max - \min} \quad (5)$$

If saturation, S, is O (zero) then hue is undefined (ie the colour has no hue therefore it is monochrome) other wise then, If R = max and G =min

H= 5+B' (6)

else if G = max and B = min

H=R'+1 (7)

else if R = max and G ≠min

H = 1-G' (8)

else if G=max and B≠min

H=3-B' (9)

else if R=max

H=3+G' (10)

Otherwise

H=5-R' (11)

Hue, H, is then converted to degrees by multiplying by 60 giving HSV with S and V between 0 and 1 and H between 0 and 360.

Methodology to Identify Alternaria Blight disease in Bittergourd leafs at Germination stage

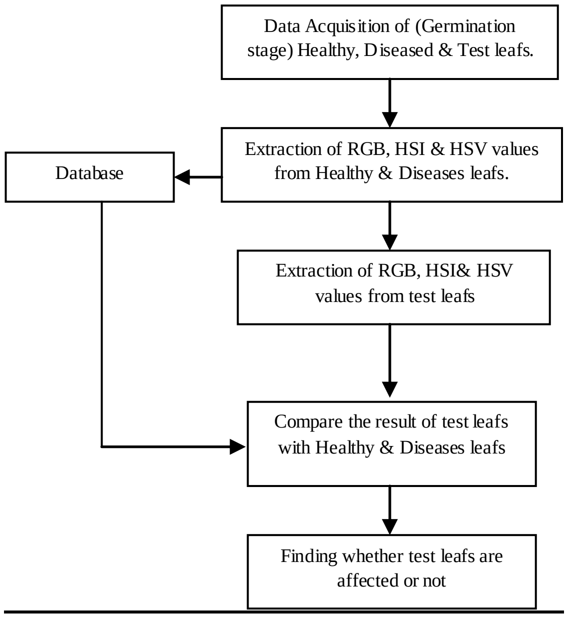

Diagram1. Method to Identify Alternaria Blight disease at Germination stage

A. Collection of Healthy, Diseased and Test leafs

In Germination stage leafs are grouped into three Healthy, Diseased and Test leafs. A total of 150 images of healthy, diseased and test leafs were taken as shown in Diagram1. Diseased leafs are further divided into five groups 10%, 20%, 40%, 80%, 100%.

B. Healthy and diseased leafs

The minimum values of RGB, HSI and HSV from healthy and diseased leafs are extracted and stored.

C. Test leafs

Minimum value of RGB, HSI, HSV are extracted from test leafs.

D. Comparing and finding affected leafs

RGB, HSI, HSV values of test leafs are compared with values of healthy and diseased leafs.

Result

100no. s of healthy and diseased leafs were taken, the minimum value of healthy and diseased leafs are shown in Table1. The RGB, HSI& HSV images of healthy, diseased and test leafs are shown in figure7, 8 and 19. The Graphical User Interface results of healthy, diseased and test leafs are shown in figure10, 11 and 12. Randomly selected 50 leafs are used for testing as shown in Table 2. The minimum value of R, G, B, I and V is taken. The results shows that out of 50 leafs, 2 leafs were infected by Alternaria Blight disease.

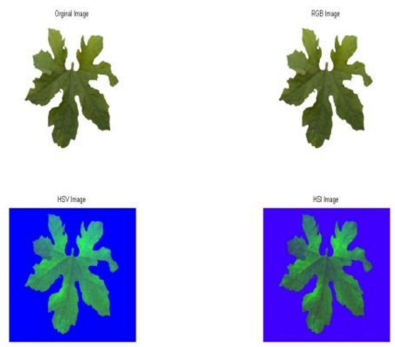

Fig 7. Image of healthy leaf (RGB, HSI&HSV)

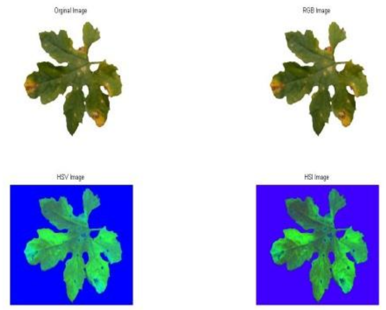

Fig 8. Image of Disease leaf (RGB, HSI&HSV)

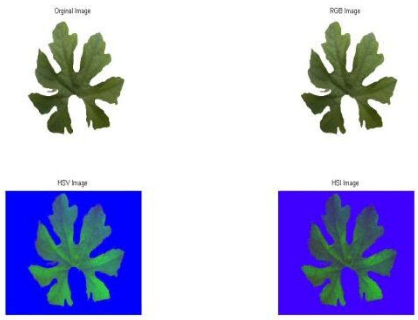

Fig 9. Image of Test leaf (RGB, HSI&HSV)

Fig 10. Result of Healthy leaf Extraction

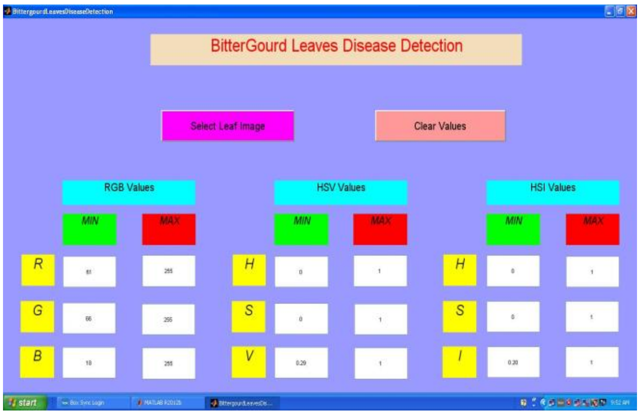

Fig 11. Result of Diseased leaf Extraction

Fig 12. Result of Test leaf Extraction

Table 1. Minimum value of Healthy and Diseased Leaf

Type of Leafs	Red	Green	Blue	value	Intensity
Healthy Leafs	56	56	16	0. 28	0. 18
Diseased Leafs	43	31	13	0. 26	0. 15

Table 2. Randomly selected Test leafs

No: of leafs	Leaf	Red	Green	Blue	Value	Intensity	Healthy / Infected
1	Front	58	60	18	0. 30	0. 22	Healthy
	Back	60	62	20	0. 29	0. 20	
2	Front	60	62	19	0. 31	0. 19	Healthy
	Back	57	59	20	0. 29	0. 20	
3	Front	57	58	19	0. 32	0. 23	Healthy
	Back	60	57	17	0. 30	0. 25	
4	Front	58	60	19	0. 31	0. 19	Healthy
	Back	59	61	17	0. 32	0. 20	
5	Front	60	62	18	0. 31	0. 20	Healthy
	Back	62	58	19	0. 29	0. 19	
6	Front	60	62	18	0. 29	0. 20	Healthy
	Back	57	60	17	0. 30	0. 21	
7	Front	58	60	19	0. 31	0. 20	Healthy
	Back	57	61	20	0. 29	0. 19	
8	Front	62	59	18	0. 29	0. 19	Healthy
	Back	60	60	17	0. 30	0. 20	
9	Front	50	52	17	0. 28	0. 19	Infected
	Back	57	50	19	0. 29	0. 19	
10	Front	63	58	18	0. 29	0. 20	Healthy
	Back	59	60	19	0. 30	0. 19	
11	Front	58	59	17	0. 29	0. 20	Healthy
	Back	63	64	19	0. 31	0. 22	
12	Front	60	59	18	0. 29	0. 20	Healthy
	Back	58	60	17	0. 31	0. 19	
13	Front	60	59	17	0. 29	0. 21	Healthy
	Back	62	61	19	0. 32	0. 23	
14	Front	58	60	17	0. 31	0. 19	Healthy
	Back	61	63	20	0. 29	0. 20	
15	Front	62	60	17	0. 30	0. 19	Healthy
	Back	59	59	20	0. 28	0. 22	
16	Front	50	57	15	0. 21	0. 19	Infected
	Back	51	56	14	0. 28	0. 21	
17	Front	60	61	17	0. 29	0. 22	Healthy
	Back	62	57	20	0. 31	0. 19	
18	Front	61	57	17	0. 29	0. 23	Healthy
	Back	59	59	20	0. 31	0. 19	
19	Front	57	59	17	0. 32	0. 20	Healthy
	Back	60	57	20	0. 29	0. 22	
20	Front	58	59	18	0. 30	0. 19	Healthy
	Back	60	62	17	0. 32	0. 20	
21	Front	59	61	17	0. 31	0. 19	Healthy
	Back	61	63	18	0. 28	0. 22	
22	Front	63	59	17	0. 29	0. 20	Healthy
	Back	57	62	19	0. 32	0. 23	
23	Front	60	64	19	0. 29	0. 20	Healthy
	Back	63	62	20	0. 31	0. 19	
24	Front	57	61	18	0. 29	0. 19	Healthy
	Back	60	63	17	0. 30	0. 20	
25	Front	57	58	17	0. 29	0. 20	Healthy
	Back	61	62	20	0. 31	0. 22	
26	Front	59	63	17	0. 29	0. 19	Healthy
	Back	61	59	19	0. 30	0. 20	
27	Front	59	58	17	0. 31	0. 20	Healthy
	Back	63	65	16	0. 28	0. 21	
28	Front	61	58	17	0. 29	0. 19	Healthy
	Back	58	63	16	0. 30	0. 20	
29	Front	59	63	18	0. 31	0. 20	Healthy
	Back	61	60	19	0. 28	0. 22	
30	Front	58	63	17	0. 30	0. 19	Healthy
	Back	60	59	18	0. 29	0. 20	
31	Front	58	61	17	0. 29	0. 19	Healthy
	Back	60	64	16	0. 31	0. 20	
32	Front	57	63	17	0. 29	0. 19	Healthy
	Back	60	60	18	0. 28	0. 20	
33	Front	56	56	17	0. 29	0. 19	Infected
	Back	58	60	18	0. 30	0. 21	
34	Front	60	63	17	0. 30	0. 19	Healthy
	Back	58	59	20	0. 29	0. 20	
35	Front	58	59	18	0. 30	0. 19	Healthy
	Back	63	62	19	0. 29	0. 22	
36	Front	58	63	17	0. 29	0. 19	Healthy
	Back	60	50	22	0. 30	0. 20	
37	Front	57	63	17	0. 29	0. 20	Healthy
	Back	60	59	20	0. 30	0. 22	
38	Front	58	57	17	0. 29	0. 21	Healthy
	Back	60	61	20	0. 30	0. 19	
39	Front	57	58	17	0. 31	0. 19	Healthy
	Back	61	60	19	0. 29	0. 20	
40	Front	59	62	17	0. 29	0. 19	Healthy
	Back	61	60	20	0. 31	0. 20	
41	Front	63	61	17	0. 31	0. 20	Healthy
	Back	58	63	21	0. 20	0. 20	
42	Front	57	61	17	0. 31	0. 19	Healthy

	Back	59	64	21	0. 27	0. 21	
43	Front	60	59	17	0. 30	0. 19	Healthy
	Back	61	60	20	0. 29	0. 20	
44	Front	56	57	19	0. 29	0. 19	Infected
	Back	59	58	18	0. 30	0. 20	
45	Front	58	62	17	0. 30	0. 19	Healthy
	Back	60	61	20	0. 31	0. 22	
46	Front	60	61	18	0. 29	0. 19	Healthy
	Back	62	65	20	0. 31	0. 22	
47	Front	59	61	17	0. 29	0. 19	Healthy
	Back	60	62	19	0. 32	0. 21	
48	Front	58	62	17	0. 31	0. 19	Healthy
	Back	57	59	18	0. 29	0. 20	
49	Front	57	60	17	0. 29	0. 19	Healthy
	Back	58	61	18	0. 30	0. 21	
50	Front	61	69	17	0. 30	0. 20	Healthy
	Back	63	68	20	0. 31	0. 22	

Limitations

To get a good quality image a constant background is needed. The quality of image will be hampered in cloudy atmosphere, by the presence of rain drops over leafs. Also leafs may acquire different shapes like wrinkling etc, thus causing difficulty in extracting image.

Conclusion

In this study, out of 50 leafs, 2 are infected by Alternaria blight disease. The percentage of affection is different in each leafs. This will help farmers take remedial measures and early detection of disease.

Reference

[1] LiliMa Junlongtand Yuehua chen, Shujpeng Gong'Color Analysis of leaf images of Deficiencies and Excess Nitrogen content in soybean leaves', E-productE-service and E-Entertainment, 2010, pp. 1-3.

[2] P. VBalachandran, 'Package of practice Recommendatios', (Kerala Agricultural University Press, Mannuthy, Kerala, India 2011), pp. 173-17.

[3] Rafael C. Gonazalez, Richard E. Woods, 'Digital Image Processing', Third Edition, (Manipal press India 2011), pp. 403-411.

[4] SamAbraham, Dr. T. SBalaubramanian, Dr. Dhanase-karan, 'Literature review for the detection of disease in bittergourd leaves', International Journal of Application or Innovation in Engineering and Management', 2014, 3, (11), pp. 50-53.

[5] 'Production Technologies and Marketing Strategies of vegetable crops of Central India', http://www. jnkvv-vegsoft. com/, accessed July 2015.

[6] SamAbraham, Dr. T. S Balasubramanian, Dr. Dhana-sekaran, 'Early detection of disease in bitter-gourd leafs at floweringStage', International Journal of Application or Innovation in Engineering and Management, 2015, 3, (11), pp. 50-53..

[7] J. Vijayakumar and S. Arumugan, 'Foot Rot Disease Identification for Vallaikorti Variety of Betelvine plant Usingdigital image processing', ICTACT Journal an Image and VideoProcessing, 2012, 03, (02).

[8] MinigyinYao, MuhuaLin, LinHuang, Jinhuizhao, ' Identification of Nutrition Elements in Orange Lea-ves by Laser Induced Break down Spectros copy ', Intelligent Information Technology and Security Informatics, 2010, pp. 398-401.

[9] 'National Horticulture Board'http://www. nhb. gov. in/vegetable/bittergourd/bit02. pdf, accessedJuly, 2015.

[10] 'Purdue Agriculture', Horticulture and Landscape Architecture, ag. purdue. edu/hla/Pages/default aspx, http://www. hort. purdue. edu/newcrop/ proceedings1996.

[11] Sara Ding, 'Juicing-for-Health', http://juicing for health. com/basic-nutrition/healing-benefits-of-bittergourd. html, accessed Sept 2015.

[12] JuanIgnacio Arribas, Gonzalo V. Sanchez-Ferrero, GonzaloRuiz-Ruiz, Jaime Gomez-Gil, 'Leaf classification in sunflower crops by computer vision and neural networks', Computer and Agric-ulture, 2011, 78, (1), pp. 9-18.

[13] Andre Ricardo Backes, DalcimarCasanova, Odemir Martinez Bruno, 'Color texture Analysis ba based on fractal descriptors', 2012, 45, (5), pp. 1984-1992.

[14] Xiaodong Tang, Manhua Liu, Hui zhao, Wei Tao, 'Leaf Extraction from Complicated Back gro-und', Image and signal processing, 2009, pp. 1-5.

[15] Nunik Noviana Kurniawati, Siti Norul Huda Sheikh Ad Abdullah, Salwani Ad Abdullah, Saad-Abdullah'Texture Analysis for Diagnosing Paddy Disease', Electrical Engineering and Inform-atics, 2009, (1), pp. 23-27.

[16] R. Pydipati, T. F. Burks, W. S. Lee, 'Identification of citrus disease using color texture feature and discriminate analysis', Computer andElectronics in agriculture, 2006, 52, (1-2), pp. 49-59.

[17] A Camargo, J. S. Smith 'An Image Processing based algorithm to automatically identify plant-disease visual symptoms', Biosystems engineering, 2009, (102), pp. 9-12.

[18] Nunik Noviana Kurniawati, Siti Norul Huda Sheikh Ad Abdullah, Salwani Ad Abdullah, Saad Abdullah'Investigation on Image Processing Techniques for Diagnosing Paddy Diseases', Inter-national Conference of Soft Computing andPattern Recognition, 2009, (4-7), DOI: 10. 1109/So CPaR. 200 9. 62 pp. 272-277.

[19] Jing Hu, Daoliang Li, Qingling Duan, Yueqi Han, GuifenChen, XiuliSi, 'Fishspecies classification by color, texture and multi-class support vect-or machine using computer vision', Computer and Electronics in Agriculture, 2012, pp. 133-140.

[20] Gao Li, Ling Xiao-ming, 'Color Edge detection based on Mathematical Morphology in HSI Space', International Conference on Computer and Information Application, 2010, DOI:10. 11. 09/ICCIA. 2010. 6141522, pp. 5-8.