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Brown Spot and Narrow Brown Spot Paddy Disease Detection using Color Slicing Method

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Abstract: In this research, the main objective is to develop a system that can detect the paddy leaves disease namely Brown Spot Disease (BS) and Narrow Brown Spot Disease (NBS). The idea of this paper is to develop a technique that capable to examine the image of plant leaf by using color slicing technique and classify the type of paddy leaves disease. Early detection of paddy leaf disease will avoid the production of low quality of rice. It is also important as to ensure a high quality of paddy plant. The methodology involves image acquisition, pre-processing, thresholding process, edge detection, color slicing, masking and analysis of the paddy leaves disease. All the paddy samples is going through the RBG calculation and it is processed with the color slicing technique for the paddy disease classification. Out of 37 sample paddy leaves images used, 33 of them or 89% are correctly detect the desired disease.

Keywords: Paddy Disease, Brown Spot, Narrow Brown Spot, Color Slicing, Image Processing

1. Introduction

Nowadays, paddy plantation is considered as one of the most crucial agriculture activities in Asian countries. Other than maize and wheat, paddy rice also is one of the world's three largest cereals and have the highest production in the world. Paddy is considered as one of the staple food in Asian

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countries especially in Malaysia. There are certain states in Malaysia such as Selangor, Kedah, Sabah, Sarawak and other states that have planted paddy for their daily meals and also as their source of income. Malaysia still imported rice from other neighbour countries even though it has own paddy field, as the existing rice is still not enough [1] . Unlike other globally important crops like corn and soy, paddy or rice is directly consumed by the global population especially in Asian countries [2].

The scientific name of paddy plant is Oryza sativa or commonly known as Asian rice. Practically paddy can be grown anywhere for example on mountain or even on a steep hill area as long as there is enough water-flow to the paddy plant. Water-controlling terrace systems is used for paddy plantation on mountain or hill to ensure the paddy plant get enough water. As for the paddy plantation on the straight land or lowland, it required a lot of water to grow and usually it can make high production of rice [1].

The market for rice is volatile and 80% of it controlled by the only five countries which are Thailand, Vietnam, India, United State and Pakistan [3]. A little change in production for any of these country could bring a downstream consequences to primary rice consumer country like Malaysia. One of the factor that leads to slow paddy production is paddy disease that will make an abnormal condition that injuries the plant or causes it to function improperly [4].

In the agricultural industry, disease is the number one enemy for the farmers. For paddy plant there are three main factors that threatened the growing and production which is from animal, bacteria and also other parasite plant that growing together with the paddy plant. The parasite plant will take the nutrients and other basic needs too. One of the main factor that affect the low production of paddy is paddy disease. At early stages the disease can be detect at the paddy leaves. This disease usually cause by bacteria or fungal that made an abnormal condition that make injuries to the plant. There are a lot of paddy diseases types, but this research focuses only on three paddy disease that have the same symptoms but actually have different approach to solve the diseases. Three main early stages diseases are Bacteria Light Blast Disease (BLB), Brown Spot Disease (BS) [5] and Narrow Brown Spot Disease (NBS). Thus to have a good quality of rice and also to increase the number of rice production, an early prevention have to take place to detect these diseases [1].

2. Literature Review

A slow production of paddy is caused by many factors such as insect or animal, nematodes, disease, parasite weeds, bacteria or fungi and also other pest. Disease of plant can be grouped into two major which are plant disorders and plant disease. Plant disorder is a state of disruption of the plant that caused by the external factors such as soil problem or other physical effect such as insect damage. While plant disease is impairment of normal physiological functioning of plant caused by disease causing agent such as bacteria, fungi viruses or nematodes. This project focuses the diseases on the paddy leaf which are Blast Disease (BD), Brown Spot Disease (BSP), and Narrow Brown Spot Disease (NBSD) [6].

For Blast fungus magnaporthe oryzae is responsible for the paddy disease. Blast can occur in paddy in all growth stages, and all part of plant wherever the Blast spores are present. The infection of this disease normally occurs on leaves and neck of the plant where a small specks originate on the leaves and enlarging into spindle shape spots which is has length from 0.5 cm to 1.5 cm and width of 0.3 to 0.5cm with ashy center and brownish border. Later, several spots will coalesce and make a big irregular patches and end up killing the entire leaves. Normally it is present in low soil moisture, rain shower and cooled temperature [7].

The most common paddy disease is Brown spot. It can kill the whole leaf. Areas having high humidity which is from 86% to100% and nutrient deficient soil leads to this disease. The fungus in the seed can survey for 4 years. Infection is very critical during ripening stages of the crop. Normally for Brown Spot Disease, the initial lesions are water-soaked to greenish gray and slowly will become grayish white with brown margin. The lesions usually on the leaves sheaths waterline due to the

presence of sclerotia. Same like BLB, the lesions of Brown Spot Disease may coalesce and kill the whole leaf [7].

The fungus sphaerunlina oryzina is responsible for the narrow brown spot. Potassium deficient soils with temperature of 25-28ºC leads to this disease. It appears in rice crops during the later stages of the plant. Lesions progressing parallel to veins in leaf are dark brown color which is 2-10mm long and 1-1.5mm wide. On the resistant varieties, the lesions will become narrower, shorter and darker of brown in color. Then it will become wider and lighter brown with gray necrotic centers on the susceptible varieties. They may connect together creating the large numbers of brown necrotic regions which leads to discoloration during the later growth stages [6].

In agriculture, the quality of the product produce is the most important thing towards the farmer. There are a few examples of application of image processing in agricultural field such as counting the production of fruit, detection of trees in a field, detection of diseases for specific plant and also detection quality of fruits [8].

One of the challenges in continual fruit cultivations is to measure the quantity of fruits on a tree. In computer vision, the ways to detect the tree at the same time counting the fruit is likely difficult as it has to get the yield estimation for different farm operation. One of the popular method used to detect and count each fruit is color thresholding method and also Circular Hough Transform (CHT) [9].

There are many bacteria disease as well as pest that attack the chili plant. Usually the bacteria and pest will attack the leaves and stems and lastly will kill the entire plant [10]. To prevent and cure this disease, the sample image of the plant is captured and being processed using image processing techniques to get to know the status of the healthiness of the plant. The advantage of this method is that the farmer can control the chemicals used and only use it if the plant is affected by a disease.

One of the appropriate method in detecting the existence of the disease on plant is by applying the color slicing method. The general idea on color slicing is to separate the specific object from their surroundings by making selection, filter and set the color of curiosity so that it can stay out of background. Besides, this method also will develop and exploit the region at specific colors and perform a masking process for a better detection. Slicing the color image will convert all other colors that is not in the range of interest to a neutral or black color [11-12].

3. Methodology

Figure 1 shows the flowchart to detect the disease on the paddy leaves. The input images are obtained from https://sites.google.com/uthm.edu.my/riceimageprocessing/home, a website with collection of paddy images for education and research purposes. These images are converted into grayscale image where this process will change the colorful image into black and white image [11]. Then, the value of the threshold is being estimate. Color slicing method is then used to separate the red, blue and green color [12]. Then input image will be layered with mask before the disease is being identify and the result of the disease is display.

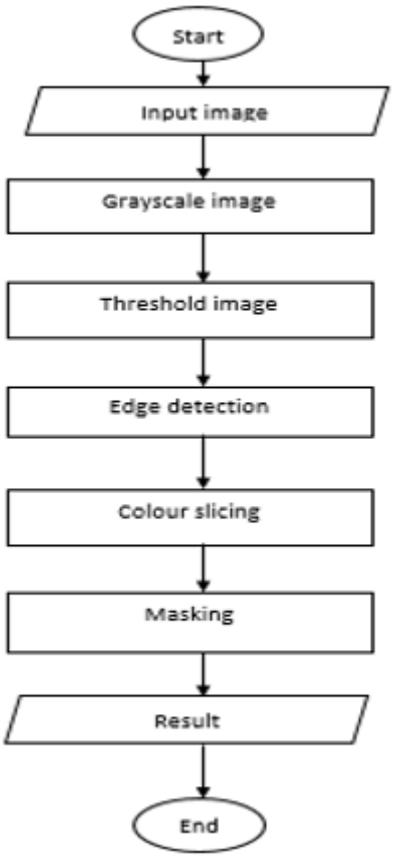


Figure 1: Flowchart to detect disease on the paddy leaves

The step started by taking the input image to store in the Matlab. The pre-processing step will convert the image from RGB image to grayscale image. There are several steps applied on color slicing method to identify either the leaves is healthy or not. First of all, conversion from the RGB image which is original image into grey scale image is done. This conversion is done to transform the colour image into black to white colour ranging between 0 – 255 value.

The grey scale image are filtered using the function of "medfilt2" which is stand for 2-D median filtering. 2-D median filtering is use to remove the noise. Filter must be applied because each output pixel contains the median value in the m-by-n neighborhood (m for row and n for column) around the corresponding pixel in the input image.

After that, threshold value of the image is estimated by using "im2bw" function to ease the process of pre-processing image. Threshold value is successfully estimated by using tools in Matlab named "Increment Value and Run Section". This technique will manually estimate threshold value of the image until suitable threshold value found for the image.

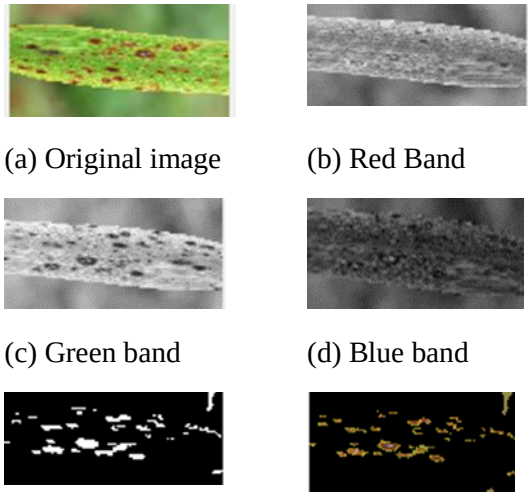
After the images are thresholded, the mask technique is used to find the desired color on image. Masking technique is a method where the Hue, Saturation, and Value image are combined into one binary image. After the red, green and blue color is detected, the morphological operation is used in smoothing the border of the region.

Prominence of specific color variance from an image is separated to a specific color object from its surroundings. By using color slicing method, the sample images will be filtered as red band, green band and blue band [11]. The sample images of paddy leaves will be processes to determine the RGB value of the images. Red, green and blue color band will be generated from the input images. The red, green and blue band are extracted from the input image into three independent two-dimensional matrices for each color part.

4. Results and Analysis

In this analysis, 37 paddy leaves images are used as sample images. From 37 sample images, 13 of it are healthy paddy leaves images, 12 sample images affected with Brown Spot Disease and another 12 sample images affected with Narrow Brown Spot Disease.

Figure 2, Figure 3 and Figure 4 shows the analysis of paddy leaves that affected with Brown Spot Disease by using Color Slicing Method. The original images shows the surface of the sample images filled with oval rounded shape that are brown in color. The sample image is filtered and categorized to their individual color bands which are red band, green band and blue band. Then the images will be computed to histogram and some color threshold range will be selected and displayed over the histogram. Next, each of the color band threshold range will be applied to the color band. The regions that are smaller than 100 pixels will be eliminated and the border were smoothed and region filled for masking. The mask component will be used again to the sample image to detect whether the sample image is healthy or has been effected with paddy leaves disease.

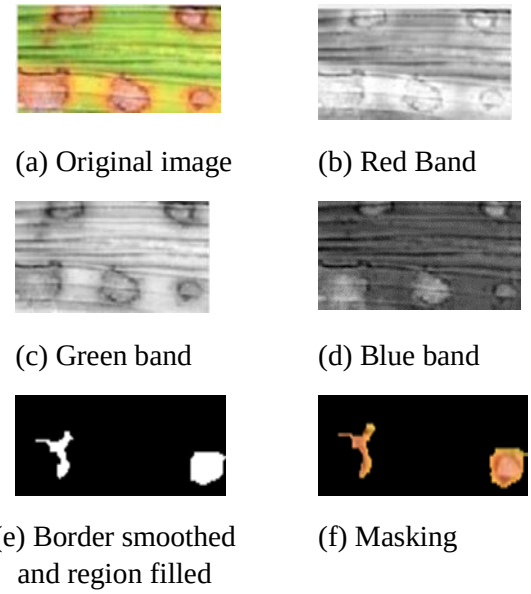


(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 2: Color Slicing Analysis with RGB (143, 120, 72) value detecting Brown Spot

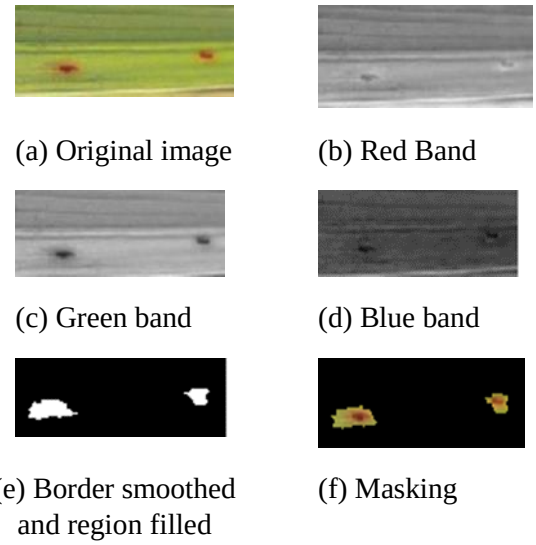


(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 3: Color Slicing Analysis with RGB (213, 141, 77) value detecting Brown Spot



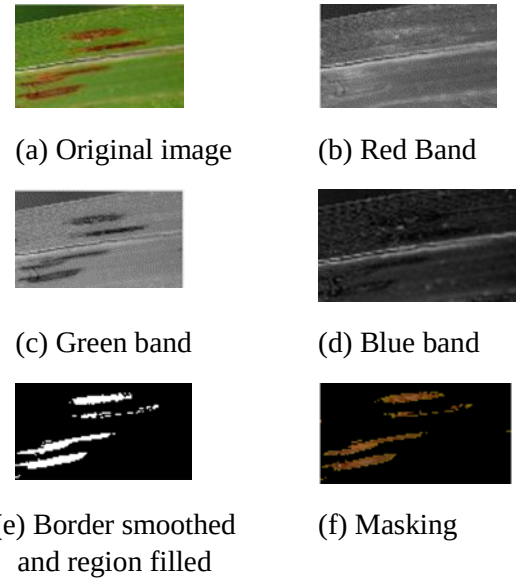
(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 4: Color Slicing Analysis with RGB (163, 131, 50) value detecting Brown Spot

Figure 5, Figure 6 and Figure 7 shows the analysis of paddy leaves that affected with Brown Spot Disease by using Color Slicing Method. From the affected sample paddy images, the Narrow Brown Spot Disease could be detected as the surface of the paddy leaves covered by small rounded color spot of solid brownish. From the result the sample images can be classified as unhealthy leaves.

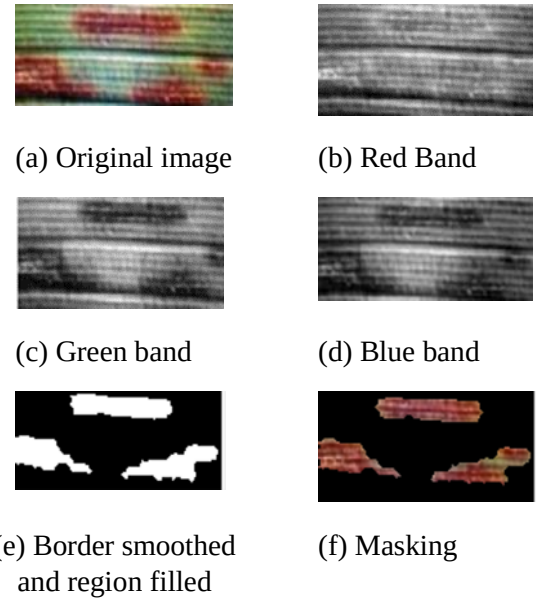


(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 5: Color Slicing Analysis with RGB (125, 96, 22) value detecting Narrow Brown Spot

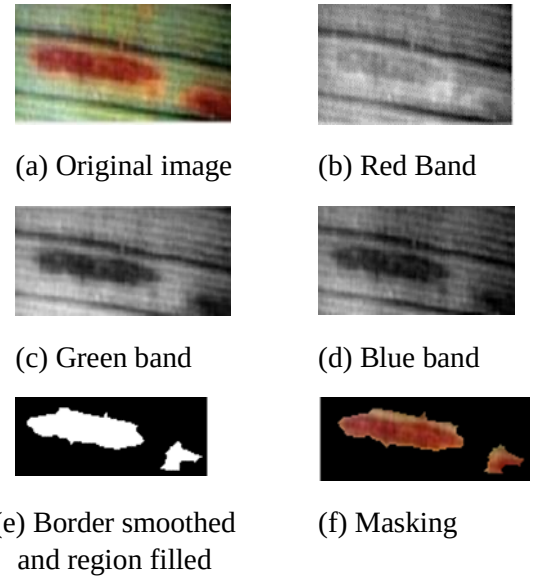


(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 6: Color Slicing Analysis with RGB (132, 79, 60) value detecting Narrow Brown Spot



(a) Original image (b) Red Band

(c) Green band (d) Blue band

(e) Border smoothed and region filled (f) Masking

Figure 7: Color Slicing Analysis with RGB (149, 73, 50) value detecting Narrow Brown Spot

From the analysis done, it was found that, for a healthy paddy plant, its red, green and blue band should be in $0<x<51$, $102<x<255$ and $0<x<76$ range respectively. While for plant that already affected with Brown Spot disease will have the red, green, blue band value in range of $67<x<220$, $47<x<141$ and $15<x<64$ respectively. Whereas, for plant that affected with Narrow Brown Spot usually will have $87<x<142$, $56<x<142$ and $10<x<92$ range for red, green, blue color band (see Table 1 for these specification).

Table 1: RGB value for specific diseases

Type of paddy disease	Minimum value of RGB	Maximum value of RGB
Normal	0,102,0	51,255,76
Brown Spot	67,47,15	220,141,64
Narrow Brown Spot	87,56,10	204,142,92

Out of 37 image leaf samples used in this research, 33 of them is correctly detected by using the proposed technique with accuracy up to 89%. 12 out of 13 normal leaf are correctly detected (see Table 2), 11 out of 12 leaf affected with Brown Spot disease are correctly detected (see Table 3) while 10 out of 12 leaf affected with Narrow Brown Spot are correctly detected (see Table 4).

Table 2: Analysis of RGB range value on healthy image

Sample	Range value of RGB			Decision
	R	G	B	
1	0	201	1	Detect
2	5	197	14	Detect
3	21	207	16	Detect
4	89	99	95	Undetected
5	19	178	23	Detect
6	30	167	21	Detect
7	21	225	19	Detect
8	27	183	16	Detect
9	19	182	11	Detect
10	22	210	13	Detect
11	10	189	17	Detect
12	24	190	21	Detect
13	15	166	20	Detect

Table 3: Analysis of RGB range value on Brown Spot affected image

Sample	Range value of RGB			Decision
	R	G	B	
1	170	132	59	Detect
2	105	88	2	Detect
3	143	120	72	Detect
4	120	72	32	Detect
5	100	73	24	Detect
6	143	128	15	Detect
7	213	141	77	Detect
8	157	130	55	Detect
9	214	134	28	Detect
10	163	131	50	Detect
11	60	182	15	Undetected
12	143	120	72	Detect

Table 4: Analysis of RGB range value on Narrow Brown Spot affected image

Sample	Range value of RGB			Decision
	R	G	B	
1	125	96	22	Detect
2	114	69	16	Detect
3	149	73	50	Detect
4	232	150	101	Undetected
5	132	79	60	Detect
6	126	128	67	Detect
7	212	163	173	Undetected
8	120	80	10	Detect
9	150	124	84	Detect
10	153	127	66	Detect
11	127	114	62	Detect
12	152	97	50	Detect

5. Conclusion

In this research, a paddy leaf disease detection system using color slicing method is developed. It can detect the present of Brown Spot and Narrow Brown Spot disease on paddy leaf. . The accuracy for this project is approximately 89%. In future, the segmentation process will be improved in order to carry out a more accurate result.

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