Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques

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***Abstract* - Producing chili is a daunting task as the plant is exposed to the attacks from various micro-organisms and bacterial diseases and pests. The symptoms of the attacks are usually distinguished through the leaves, stems or fruit inspection. This paper discusses the effective way used in performing early detection of chili disease through leaf features inspection. Leaf image is captured and processed to determine the health status of each plant. Currently the chemicals are applied to the plants periodically without considering the requirement of each plant. This technique will ensure that the chemicals only applied when the plants are detected to be effected with the diseases. The image processing techniques are used to perform hundreds of chili disease images. The plant chili disease detection through leaf image and data processing techniques is very useful and inexpensive system especially for assisting farmers in monitoring the big plantation area.**

***Keywords* - Chili disease; leaf image; image processing**

I. INTRODUCTION

Chili is included in the main horticultural commodities. At certain times, it becomes a very high demand in the market because supply is limited. Business chili indeed belongs in the high-risk plants. Therefore, strategies and technical knowledge and the field became an important matter to be mastered. The systematic and structured should be developing so that it will use by operators to increase the overall production. Many farmers refused to cultivate chili in the rainy season due to the increase of chili disease to become high risk for the quality control and productivity. Fig. 1 illustrates the samples of plant chili disease.

In general, there are two types of factors which can bring death and destruction to chili plants; living (biotic) and nonliving (a biotic) agents. Living agent's including insects, bacteria, fungi and viruses. Nonliving agents include extremes of temperature, excess moisture, poor light, insufficient nutrients, and poor soil pH and air pollutants. Diseased plants can exhibit a variety of symptoms and making diagnosis was extremely difficult. Common symptoms are includes abnormal leaf growth, color distortion, stunted growth, shriveled and damaged pods. Although pests & diseases can cause considerable yield losses or bring death to the plants and it's also was directly affect to human health. However, crop losses can be minimized, and specific treatments can be tailored to combat specific pathogens if plant diseases are correctly diagnosed and identified early. These need-based treatments also translate to economic and environmental gains.

Figure 1 Samples of plant chili disease

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II. PROBLEMS STATEMENT

Chili which is the fruit of capsicum family plant is almost a delicacy in Asian menu. This fruit has a high local demand and can fetch a very handsome economic yield. An attack by disease-causing organisms generates a complex immune response in a plant, resulting in the production of disease-specific proteins involved in plant defense and in limiting the spread of infection. Louse also produce proteins and toxins to facilitate their infection, before disease symptoms appear such as the leaf color will change. These leaf colors play vital role in the development of plant disease detection.

Influence the next phase of the attack is usually seen through the leaves stems or fruit inspection. To manage the potential problems, early identification is required and correct diagnosis of disease should provide operators to prevent before damage to the whole of plant chili and the swift implementation of preventative methods should allow the farmer to get on top of most problems before serious damage if inflicted.

The traditional method of identifying plant pathogens is through visual examination. This is often possible after major damage has already been done to the crop then treatments will be of limited or no use. To save plants from irreparable damage by louse, farmers have to be able to identify an infection even before it becomes visible.

Advances in vision technology, software technology, and biotechnology have made the development of such this disease detection is possible. These researches are designed to detect plant diseases early, either by identifying the presence of the louse in the plant (by testing for the presence of louse movement) or the color and shape produced by either the louse or the plant during infection. These techniques require minimal processing time and are more accurate in identifying louse. Other than some equipment and training, other procedures such as chili plants on-site monitoring by automatically or by a person who has no special training can be implemented. Currently, this study has been designed and the disease of chili was successfully detected. This technique also reduces the chemicals applied to the plants periodically without knowing which area that affected is.

III. MATERIALS AND METHODS

Image processing is traditionally concerned with preprocessing operations such as Fourier filtering, edge detection and morphological operations. Computer vision extends the image processing paradigm to include understanding of scene content and object classification. Therefore, this paper demonstrates the use of image processing techniques to detect the plant chili disease through leaf image.

A. System Overview

The system consists of two major parts (refer to Fig. 3) such as the digital camera and the LABVIEW software tools to build Graphical User Interface (GUI). The first part of the project is to take image photos of chili leaf. Picture need to be taken in a group of chili leaf. MATLAB 2010 is the software chosen to perform image processing on the captured image photos. Image processing of an image photo requires numerous standard procedures and steps to be able to identify and recognize the color in an image photo. It has step-by-step procedure showing the image processing of an image photo which the user only needs a few clicks on the GUI itself. Fig. 3 illustrates the block diagram of plant chili disease detection system.

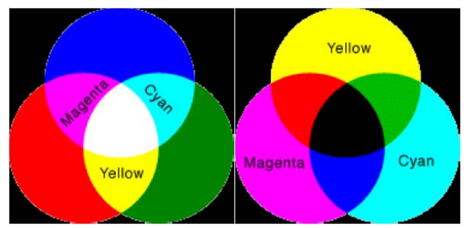

Figure 2 Primary and secondary colors of light and pigments [4][12]

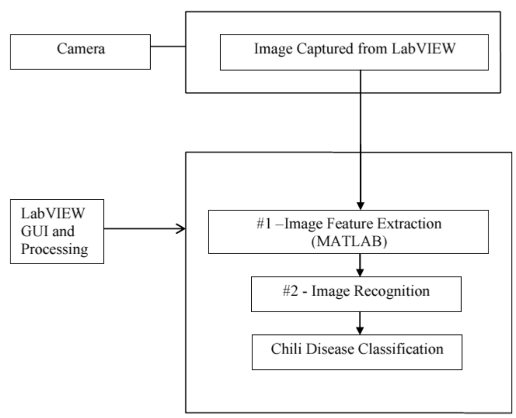

Figure 3 The diagram of plant chili disease detection system

B. Colors Fundamentals and Models

Basically, the colors that humans and some other animal perceive in an object are determined by the nature of the light reflected from the object. Due to absorption characteristics of the human eye, colors are seen as variable combinations of the primary colors red (R), green

(G), and blue (B). Fig. 2 shows the primary and secondary color to be implemented in this research paper [4][5].

The purpose of a color model is to facilitate the specification of colors in some standard, generally accepted way. In essence, a color model is a specification of a coordinate system and a subspace within that system where each color is represented by a single point. In the RGB model, each color appears in its primary spectral components of red, green, and blue [6].

This model is based on a Cartesian coordinate system is shown in Fig. 4. RGB primary values are at three corners; the secondary colors cyan, magenta, and yellow are at three other corners; black is at the origin; and white is at the corner farthest from the origin. In this model, the gray scale extends from black to white along the line joining these two points. The different colors in this model are points on or inside the cube, and are defined by vectors extending from the origin [4][7].

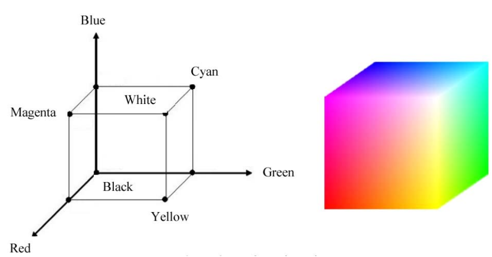

Figure 4 The RGB colors cube [4][12]

C. *Image Captured*

The photo image prepared as experiment sample for this research paper have some fixed details. Both of the healthy and diseased leaf samples were used for the experimental purpose of this system. For better result, the leaves sample should be in good condition and sharp. Throughout the photo capturing section, the distance of the camera and the leaf was adjustable in order to get a clear shot of leaf pattern.

The input photo image is a JPG image file and the size of resolution is 3872 x 2592 pixels.

a=imread('A(1).JPG');
A=imresize(a, [800 536]);

The *imread* function is read image from graphics file. The *imresize* function is to returns an image of the size specified by [m-rows n-cols]. Images are resized for easier image processing. Fig. 5 shows the block diagram to capture the image [10][11].

TABLE 1
THE PHOTO IMAGE CHARACTERISTIC

Type	Leaf sample image	WebCAM image
Format	JPG	PNG
Resolution [m,n]	800 x 536 pixels	640 x 480 pixels
Columns, m	800	600
Rows, n	536	480

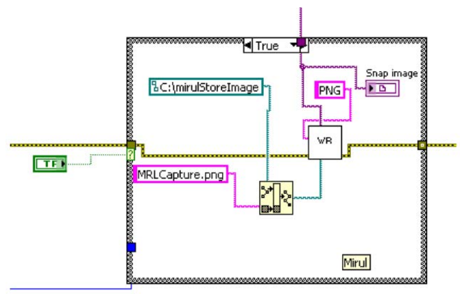

Figure 5 The Image captured using LABVIEW IMAQ Vision

Figure 6 The healthy of plant chili

Figure 7 The plant chili disease

D. Images Feature Extraction

The input image is enhanced to preserve information of the affected pixels before extracting chili leaf color from the background [1][2]. The color space respectively is used to reduce effect of illumination and distinguish between chili and non-chili leaf color efficiently [3]. The resulting color pixels are clustered to obtain groups of colors in the image is shown in Fig. 8.

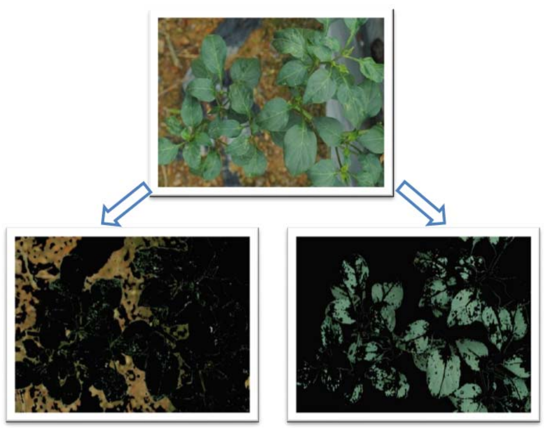

Figure 8 The result of color clustering

E. Image Recognition

Extracts the color features of an image, which can be used for color matching or other applications related with color information, such as color identification and color image segmentation [8][9][10]. Fig. 9 shows the result of histogram graph after the clustering method.

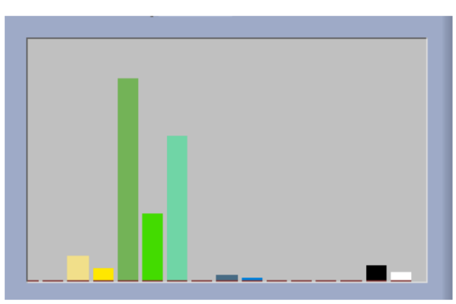

Figure 9 The result of histogram graph

IV. RESULTS AND DISCUSSION

The system was tested with image of 800x536 pixels. The total samples are 107. There are 21 healthy leaf sample and 86 diseased leaf samples. The graphical user interface (GUI) result of healthy and disease plant chili is shown in Fig. 10 and Fig. 11. All the plant chili samples are tested. Table 2 and Fig. 12 show the result of plant chili healthy and disease that was implemented in this paper.

Figure 10 The result of healthy plant chili

Figure 11 The result of plant chili disease

The method implemented in this research paper is effective and fastest method in detection of plant chili disease. The overall result was satisfying and is considered as a successful project. This paper has introduced a number of techniques in image processing for image and color recognition of an image photo.

As a conclusion, this research strongly recommends to be use for early detection of plant chili disease through leaf inspection. Leaves images captured are processed to determine the healthiness of each plant. By using leaf recognition technique, it does will identify the potential problems to the chili plants before its goes seriously damage for all chili plants. With this method, the use of harmful chemicals on plants can be reduced and hence ensure a healthier environment and may be even lowering the production cost of the maintenance and producing a high quality of chili.

TABLE 2
THE PLANT CHILI HEALTHY AND RISKY RESULT

Sample	Yellow	Cyan	Green	Healthy/Disease
1	0.000	0.000	4.259	Healthy
2	0.014	0.007	22.916	Healthy
3	0.190	18.519	0.000	Healthy
4	0.003	11.199	0.060	Healthy
5	0.000	18.116	0.000	Healthy
6	0.067	12.605	9.351	Healthy
7	0.035	10.347	0.000	Healthy
8	0.000	24.711	0.050	Healthy
9	0.000	17.073	0.608	Healthy
10	0.000	28.316	0.350	Healthy
11	0.040	1.454	0.793	Healthy
12	0.000	0.462	6.128	Healthy
13	0.413	14.474	0.000	Healthy
14	0.521	0.000	31.742	Healthy
15	0.216	0.279	14.049	Healthy
16	0.030	0.023	3.772	Healthy
17	0.000	2.102	0.79	Healthy
18	0.139	0.000	0.858	Healthy
19	0.828	0.060	20.417	Healthy
20	0.226	0.443	7.926	Healthy
21	0.000	19.670	5.455	Healthy
22	4.022	3.234	0.639	Risky
23	1.107	24.883	14.129	Risky
24	1.825	0.001	17.16	Risky
25	1.802	3.719	1.266	Risky
26	1.067	15.543	2.349	Risky
27	2.917	13.511	0.000	Risky
28	1.405	0.000	6.675	Risky
29	3.379	0.000	10.29	Risky
30	1.212	6.084	12.857	Risky
31	3.786	0.000	2.595	Risky
32	2.656	0.000	17.863	Risky
33	4.117	0.000	8.305	Risky
34	1.085	0.000	14.458	Risky
35	1.289	0.000	17.391	Risky
36	1.453	0.000	10.385	Risky
37	2.932	0.000	19.905	Risky
38	3.946	0.000	3.922	Risky
39	3.774	0.000	12.555	Risky
40	4.066	0.000	4.595	Risky
41	2.539	0.000	3.789	Risky
42	3.151	0.000	1.137	Risky
43	3.542	0.000	9.456	Risky
44	6.928	0.000	0.936	Risky
45	6.739	0.000	11.402	Risky
46	1.737	7.758	2.524	Risky
47	2.743	7.614	3.367	Risky
48	9.809	0.002	7.415	Risky
49	7.743	0.000	9.139	Risky
50	8.966	0.000	4.166	Risky
51	2.715	10.842	2.031	Risky
52	3.606	0.000	12.1	Risky
53	2.373	0.171	17.61	Risky
54	3.601	0.000	2.848	Risky
55	6.074	0.000	4.008	Risky
56	1.126	3.059	16	Risky
57	3.351	0.44	10.491	Risky
58	4.336	12.911	0.293	Risky
59	4.558	1.927	6.556	Risky
60	12.981	0.000	28.157	Risky

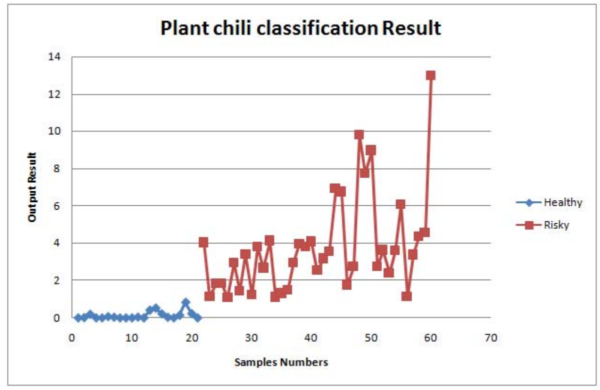

Figure 12 The plant chili classification result (Healthy and Risky)

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