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The System Development of Durian Types Classification Using the Color Intensity Technique

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Abstract
The purpose of this study was to develop software to categorize Durian types applying color categorization. The principle of the software was to analyze the mean of color intensity which focused on the green and blue color groups. The results of efficiency assessment were gathered from the developed Algorithm.There were 9 groups of the sample images which each group contained 5 images, 45 images in total. The precision of Group 1: Mon Thong was 80%, Group 2: Kan Yao was 80%, Group 4: Long Lab Lae was 80%, 5: Nok Yip was 80%, 6: Kradum Thong was 80%, Group7: Kop Chainam was 80%, Group 8: Thong Yoi Chat was 80% and Group 9: Phuang Mani was 80%, the average mean was 80%. The overview of the developed software was considered at a good level which confirmed that the color comparison was rather precise. In addition, it would be suitable to be applied in the analysis of the image color intensity.

Keywords: classification, image processing, software, Algorithm, color intensity

Introduction

Durian is named King of fruits. It is a long-lived tree grown and well-cultivated in the tropical region of 10-46 °**C**. Durian is a vital fruit of Thailand that is not only for domestic consumption but also for international export earning a large amount of revenue [1]. Today, it is crucial to apply information technology in fruit classification in several studies related to the color of fruits using RGB colors [2]. and for the image analysis of apple defect detection [3]. Particularly, there are numerous species of Durians, which people, in general, cannot categorize the species without knowledge and experience of durians. Thus, it is highly probable that technology would be in this matter.

The cost will be high at the start; however, it will be worth it in the long run. Today, Information Technology (IT) is much developed. It affects the lower cost of production; thus, people with low income can afford inexpensive devices with high precision. Generally, durian color classification relies on the color comparison and types of durians. Experience and personal specialization are essential for people who can classify durians. People, in general, are not able to do this job due to the lack of specific experience related to durians. For those with experience are able to know and accurately categorize durians by their colors. The research is aware of the importance of the use of technology in the area mentioned earlier. So, the researcher studied and designed the Algorithm to compare and classify types

of durians using the mean levels of color intensity for applying in durian color classification. The focus was on the comparison of levels of color intensity to apply in durian color classification. It could be implemented in the physical classification of durian color from detecting cameras [4],[5]. and other sensors [6]. The system that the researcher studied and developed could be seen in a similar study; for instance, the rotten apple detection using color categorization with the speed of 30 apples per minute, the precision was 92% [1],[7]. The artificial neural network is also used with a precision of 93% [8]. It is a system specially designed to identify the level of color intensity of durians from the images taken by the camera. It was used as a guideline for the study and developing for future implementation to increase the proficiency of the related work.

Materials and Methods

b. *Identifying problem*

Due to the problems of farmers and tourists in some Durian farms lack skill and experience to classify the types of Durians. The numerous Durian experts are crucial in the Durian classification process to analyze the kinds of Durian by looking at the color and meat of durians. There is a limited number of experts who specialize in this area. There is the necessity to apply technology in agriculture and tourist service that lead to the development of devices and software to lower the cost of workers. Applying technology in agriculture and improving agricultural equipment increase the production capability and decreases the cost and time in production.

(a)Color Intensity Analysis of RGB

durian type	R	G	B	durian type	R	G	B	durian type	R	G	B
1.Mon Thong 	205	194	109	4.Long Lap Lae 	212	200	139	7.Kop Chainam 	202	197	106
2.Kanyao 	230	206	137	5.Nok Yip 	210	194	88	8.Thong Yoi Chat 	239	214	148
3.Chanee 	216	187	121	6.Kradum Thong 	212	195	98	9.Phuang Mani 	185	157	49

FIGURE 1

Analysis of Color Intensity (Source:https://food.trueid.net/detail/M8qz0W4e4n3)

There were nine types of durians selected from several kinds of Thai durians. They served as a sample model in the analysis of RGB color intensity[9]. As presented in Figure 1.

(b) Graph © levels of 3 RGB colors

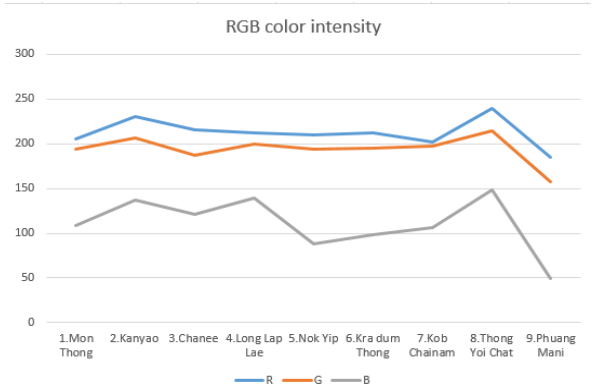

FIGURE 2

Levels of RGB color intensity

From Figure 2. The levels of RGB color intensity of 3 colors were stable and not overlapped with the other two colors: green and blue. However, the value of the red color was not stable and overlapped, so the green and blue colors were suitable for being the model colors.

The intensity level of durian species	G	B	The intensity level of durian species	G	B
1.Mon Thong	194	109	6.Kradum Thong	195	98
2.Kanyao	206	137	7.Kop Chainam	197	106
3.Chanee	187	121	8.Thong Yoi Chat	214	148
4.Long Lap Lae	200	139	9.Phuang Mani	157	49
5.Nok Yip	194	88			

FIGURE 3

The intensity level of selected G and B

© Analysis of 2 colors for Algorithm application in software development

The intensity level of durian species	G	B
1.Mon Thong	194 189-199	109 104-114
2.Kanyao	206 201-211	137 132-142
3.Chanee	187 182-192	121 116-126
4.Long Lap Lae	200 195-205	139 134-144
5.Nok Yip	194 189-199	88 83-93
6.Kradum Thong	195 190-200	98 93-103
7.Kop Chainam	197 192-202	106 101-111
8.Thong Yoi Chat	214 209-219	148 143-153
9.Phuang Mani	157 152-162	49 44-54

FIGURE 4

The Analysis of the duration of two colors

From Figure 4. The intensity of colors G and B were stable, to achieve the high precision level result, the interval of 5 plus or minus was used for system testing. It was an appropriate method for developing the Algorithmic model.

II. System Design

(b) Overview of the system context Diagram shown in Figure 5.

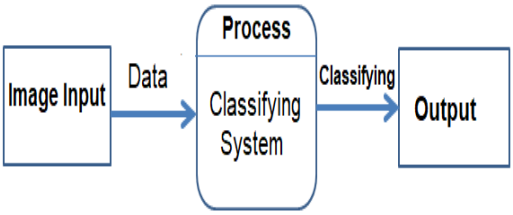

FIGURE 5

Overview of the system context Diagram

(b) System structure shown in Figure 6.

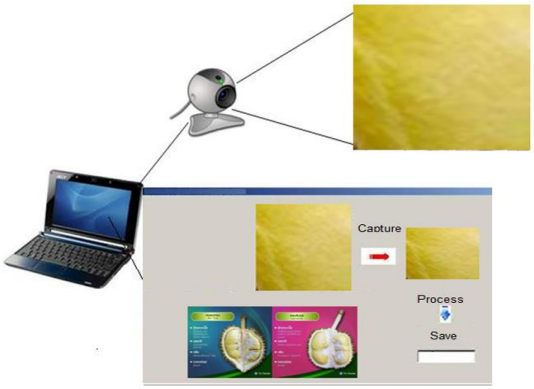

FIGURE 6

System structure

(c) System processing shown in Figure 7.

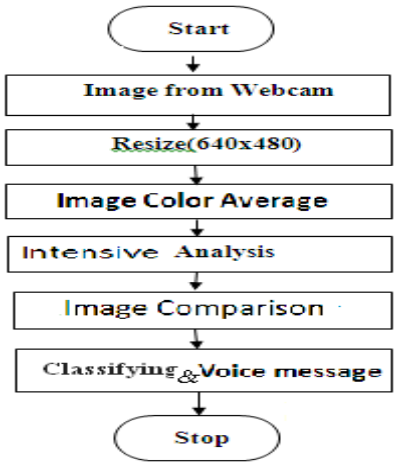

FIGURE 7

System process

(d) Algorithmic system

```
for (int i = 0; i < bmap.Width; i++)
                    {
      for (int j = 0; j <       bmap.Height; j++)
          {    color  c = bmap.GetPixel(i, j);
                        Sum_G=  Sum_G +c.G;
           Sum_B=  Sum_B +c.B;
                          }     }
         intensiveG =Sum_G/(bmap.Width*bmap.Height);
         intensiveR = Sum_B /(bmap.Width*bmap.Height);
         if ((intensiveG >= 189) && (intensiveG <= 199) ||
          (intensiveB >= 104) && (intensiveB <= 114))
                  {
        text1 = " Mon Thong ";
          }
  else      if  ((intensiveG  >=201)&&(intensiveG              <=211)  ||  (intensiveB  >=
132)&&(intensiveB <= 142)
```

```
                {

        text1 = "Kanyao";

          }

else  if ((intensiveG >=182)&&(intensiveG <=192) || (intensiveB >= 116)&&(intensiveB <=
126)

                {

        text1 = "Chanee";

          }

  else  if ((intensiveG >=195)&&(intensiveG <=205) ||(intensiveB >= 134)&&(intensiveB
<= 144)

                {

        text1 = " Long Lab Lae  ";

          }

  else if ((intensiveG >=189) && (intensiveG <=199) || (intensiveB >= 83)&&(intensiveB
<= 93)

                {

         text1 = " Nok Yip ";

        }

  else if ((intensiveG >=190)&&(intensiveG <=200) || (intensiveB >= 93)&&(intensiveB <=
103)

                {

                text1 = " Kradum Thong ";

        }

  else    if ((intensiveG >=192)&&(intensiveG <=202)||(intensiveB >= 101)&&(intensiveB
<= 111)

         {

          text1 = "Kop Chainam";

        }

  else if ((intensiveG >=209)&&(intensiveG <=219)||(intensiveB >= 143)&&(intensiveB <=
153)
```

```
{
 text1 = "Thong Yoi Chat";
}
else if ((intensiveG >=152)&&(intensiveG <=162) || (intensiveB >= 44)&&(intensiveB <= 54)
{
 text1 = " Phuang Mani";
}
SpeechSynthesizer synthesizer = new,  SpeechSynthesizer();
synthesizer.Volume = 100;  synthesizer.Rate = 0;
synthesizer.Speak(text1);
```

III. System design and development

This research developed the model system for classifying 9 popular durians among the consumers and most exported using Visual C# as a tool to create the model and user interface. A webcam was an image input device for the analysis.

(a) System context diagram

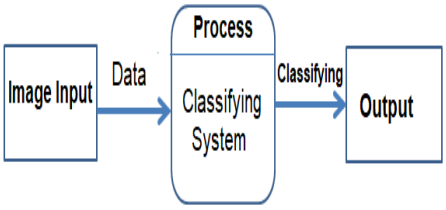

FIGURE 8

Overview of system context diagram

(b) System structure

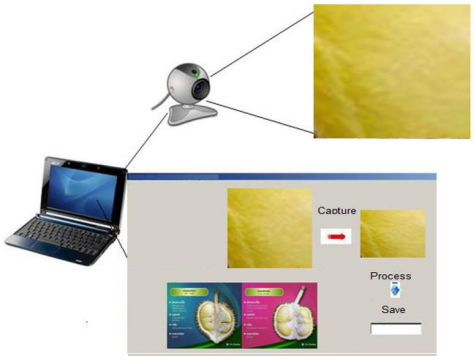

FIGURE 9

System components

Visual C# was used as a tool to develop the system model as shown in Figure 10.

FIGURE 10

Processing screen

IV. System Testing

The precision efficiency of the color comparison could be measured by the precision value method. It was the comparison of the images from the database and the datasets considering the number of images. The process was to find out how many images were in the same group as the images from the database. And it compared how many images that were in the same group of images from the database to then calculated the number, as shown in the equation[9],[10].

(General principles and define tions,ISO 5725-1, 1994.)

$$\text{Precision} = \left| \frac{x_i - x_m}{x_m} \right|$$

$$x_m = \frac{1}{n} \sum_{i=1}^{n} x_i$$

X_m = Mean

X_i = Each measurement

Results

I. System development

A user interface shown in Figure 11.

FIGURE 11 Model interface

II Results of system efficiency

The system efficiency assessment of the comparison of color intensity from the sample images was shown in quantitative and qualitative means from the database. The images were in 9 groups, 45 images in total.

After the software testing using the Black Box method, the following process was to find the system efficiency to meet the acceptance test by the user. The evaluation process was to evaluate IT proficiency and software consisting of 4 parts;

- Function Requirement Test
- Function Test
- Usability Test
- Security Test

In this case, the emphasis was on the system or software proficiency; thus, the function test criteria were used for regular digital color images. The images used were in *.jpg file type consisting of 45 images with the resolution of 640 x 480 Pixel, divided into 9 groups which each group contained 5 images.

III. Dataset of system testing

The 45 images were in *.jpg file with the resolution of 640 x 480 Pixel. They were divided into 9 groups, 5 per group.

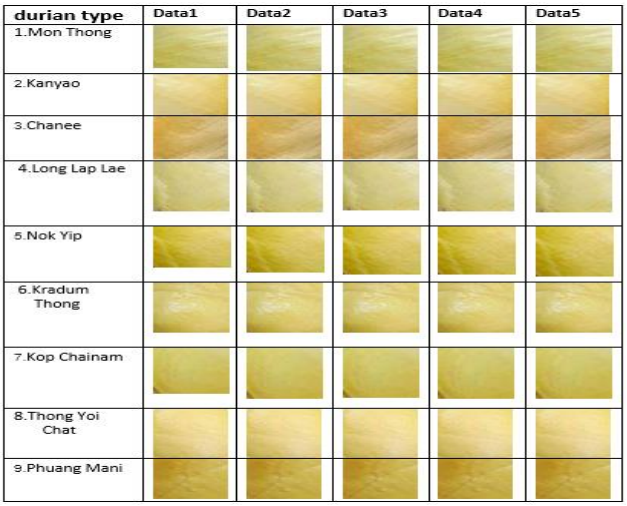

FIGURE 12

Experimental Datasets

Group 1: Mon Thong; Group 2: Kan Yao; Group 3: Chanee; Group 4: Long Lab lae; Group 5: Nok Yip; Group 6: Kradum Thong; Group7: Kop Chainam; Group 8: Thong Yoi Chat; and Group 9: Phuang Mani.

IV. Results

TABLE 1 Comparison of color intensity levels with 45 images in the datasets

Comparison of color intensity levels with those of image datasets.	number of images	Accuracy of color comparison	Average % Accuracy
1.Mon Thong	5	4	80 %
2.Kanyao	5	4	80 %
3.Chanee	5	4	80 %
4.Long Lap Lae	5	4	80 %
5.Nok Yip	5	4	80 %
6.Kra dum Thong	5	4	80 %
7.Kob Chainam	5	4	80 %
8.Thong Yoi Chat	5	4	80 %
9.Phuang Mani	5	4	80 %
Sum	45	36	80 %

The results from the precision assessment assessing the precision of the color intensity detection compared to the images in the database and the sample images. The sample images were in 9 groups, 5 per group to find the efficiency of color intensity detection, which the results showed that the precision of Group 1 was 80%, Group 2 was 80%, Group 4 was 80 %, Group 5 was 80 %, Group 6 was 80%, Group 7 was 80%, Group 8 was 80%, and Group 9 was 80%, the average mean was 80% which considered as a good efficiency.

Discussions and conclusions

According to the results of system proficiency tested by the developed Algorithm using 45 sample images with the resolution of 640x480 Pixel revealed that the precision of the image in groups 1-9 was 80% considered as good efficiency. It indicated that the comparison of color intensity levels of images was rather precise and suitable for Durian color classification.

This research uses a new principle which is to use the intensity level of the three primary colors, red, green, and blue, to measure the color values.

For the system precision, the proximity of the camera and object should not be further than 1 meter, and the room for photo taking should have the appropriate brightness. However, there should be a comparison of the other systems or related research to evaluate the precision of the developed system to detect the faults and solve any errors for the better efficiency of the system application.

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