2014 Third ICT International Student Project Conference (ICT-ISPC2014)

Flower Recognition System Based on Image Processing

Tanakorn Tiay, Pipimphorn Benyaphaichit, and Panomkhawn Riyamongkol
Department of Electrical and Computer Engineering
Faculty of Engineering, Naresuan University
Muang, Phitsanulok 65000, Thailand
tanakornt53@email.nu.ac.th, pipimphornb53@email.nu.ac.th, panomkhawnr@nu.ac.th

***Abstract*—The flower recognition system based on image processing has been developed. This system uses edge and color characteristics of flower images to classify flowers. Hu's seven-moment algorithm is applied to acquire edge characteristics. Red, green, blue, hue, and saturation characteristics are derived from histograms. K-nearest neighbor is used to classify flowers. The accuracy of this system is more than 80%.**

***Keywords*—flower recognition; flower detection; image processing; K-nearest neighbor; Hu's seven moments; graph cut**

I. Introduction

There are many flower species in the world. Some species have many colors, such as roses. It is hard to remember all flower names and their information. Furthermore, someone may be confused with similar flower species. For example, white Champaka and Champak have similar names and petal shapes but they have different colors and petal lengths.

At this time it is almost impossible to identify particular flowers or flower species in any other way but to seek information based on personal knowledge and experience of experts. Availability of such experts may be a barrier to such information seeking. Searching for such information on the Internet is, today, very much restricted to key word searching; text processing. Even in this the searcher needs to provide sufficiently useful keywords, which they cannot do, which is the crux of the matter.

This paper gives another approach to flower and plant recognition and identification; one based on image processing. Using image processing methods, people who want to know flower and species information could do so by taking photos, probably using a smart phone, but also a digital camera, or using a photo from the Internet. These photos can then be input into the image processing system proposed here and identified by the system.

II. Organisation of This paper

This paper is organized as follows. In Section I the motivation to develop this paper has been discussed; basically the view of the need for a universally available, simple to use system using what are now every-day available devices; smartphones, digital cameras, Internet images and so on. Literature reviews are also included in this section, which presents other researches related to our proposed system. Section II presents the detail of the proposed system, which starts with system overview followed by feature extraction, image analysis, and classification. The experimental results are given in section III. Lastly, section V is given a conclusion.

III. Related Work

Earlier flower recognition research was proposed by Das et al. [1]. However, only a color based algorithm was developed. It is hard to classify different flower species based purely on color; many different flowers and specifies have similar colors, and many flowers of the same species have different colors. Saitoh and Kaneto [2] developed an automatic recognition system for wild flowers. There are two input images utilised; flower and leaf. The requirement for both flower and leaf features to be analysed is a restriction of this approach In that system the piecewise linear discriminant function is used in the recognition process for 10 flower features and 11 leaf features. It is not convenient to take pictures of both flower and leaf. The system may require much time and space complexity. Another approach by Nilsback and Zisserman [3] extracted two main flower features, color and shape. Graph cut and color dependent conditional random forest algorithms were used to obtain color features. For shape features, generic shape fitting was used to detect petals. There is a problem of finding correct center of the flower. Some flowers have overlapping petals. Chai [4] developed a flower recognition process based on [3]. In the segmentation process used, the input image was divided into smaller sub-regions. Then, discriminative classifier and grabcut algorithms were applied. After that, a combination of feature selections, kernelization, SVM, heuristics and two unsupervised co-segmentation algorithms are used. It has a significant computational cost. Recently, flower recognition research via a mobile phone has been undertaken. For example, Sunpetchniyon et al. [5] proposed an image search system for flowers on a mobile phone. This system used HSV histogram as a color feature and SURF as a shape feature. The accuracy of this proposed system has been poor. Vuarnoz [6] also developed a mobile application for flower recognition as a semester project. This project uses a water shed algorithm to extract the flower area. 18 different features encompassing colors and shapes of the flower are analysed. These features are mixed and matched to receive satisfied accuracy.

However, having too many features can cause lower classification performance.

IV. The Proposed System

A. System Overview

The overview of the proposed flower recognition system based on image processing is shown in Fig.1. The first step is the image acquisition. The input image file can be a file, which is already downloaded in the computer memory or stored elsewhere and is readily available. A storage facility 'in the Cloud', such as Dropbox [7] enhances the mobility of this system. The image may be a photo downloaded from a smart phone or digital camera. The image data is pre-processed to prepare the image data for analysis. In the image analysis section, Hu's seven-moment algorithm of shapes together with RGB and HS data are used. After that, two data parts will be combined as a vector and classified by the K-nearest neighbor algorithm. Our system returns the top three most similar flower images. Finally, the output part shows input flower images, a set of candidate flower images and flower information.

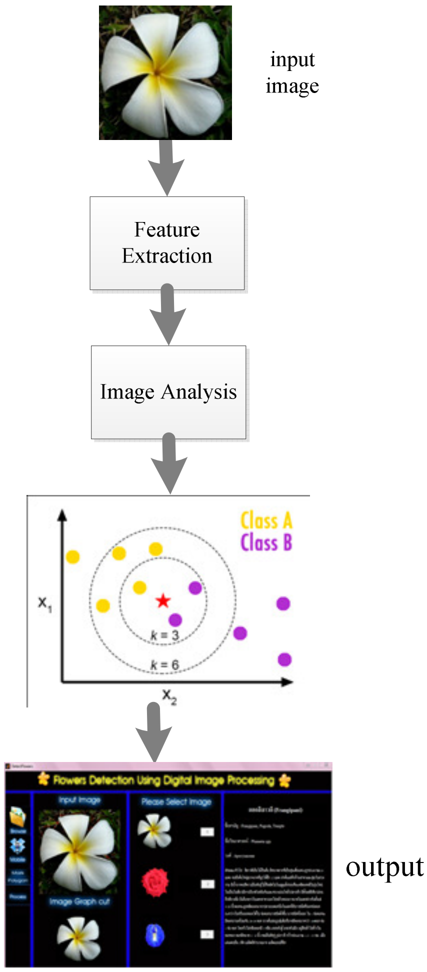

Fig. 1. The system overview of the proposed system

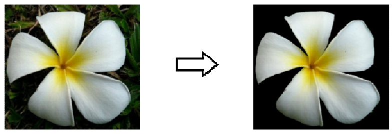

Fig. 2. Example of the images after using graph-cut algorithm

B. Feature Extraction

This section discusses the pre-processing activity to prepare image data for further analysis. Firstly, the input image is resized to half for faster processing. Then, the background of the image is eliminated by graph-cut algorithm [8] as shown in Fig. 2.

It can be seen from Fig. 2, in the right-hand side image, that the background by removed after using a graph-cut algorithm. After that, the image is transformed to be a grayscale image using average method as shown in equation (1).

$$f = (R + G + B) / 3 \tag{1}$$

where R, G, and B are red, green, and blue values of a pixel respectively. The example of images from grayscale conversion is shown in Fig. 3.

The image is then cropped automatically by searching for the top, bottom, left, and right most extents of the flower position which are used to cut out the surplus background. The example of a cropped images is shown in Fig. 4.

The Canny edge detection algorithm [9] is applied to the cropped image to receive edge data. The edge data will be the input into Hu's seven-moment algorithm in the next section. The example of images using canny edge detection algorithm is shown in Fig. 5.

Red, green, blue, hue, and saturation characteristics of image are used in the analysis section

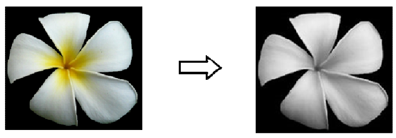

Fig. 3. Example of the images after using grayscale conversion algorithm

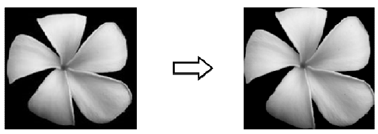

Fig. 4. Example of the cropped images

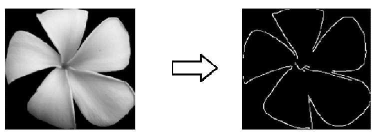

Fig. 5. Example of the edge images

C. Image Analysis

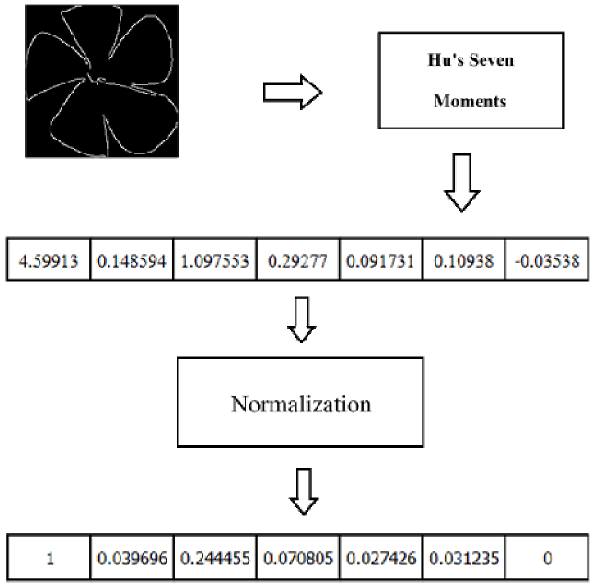

Fig. 6. Example of seven characteristics from edge data using Hu's seven-moment algorithm

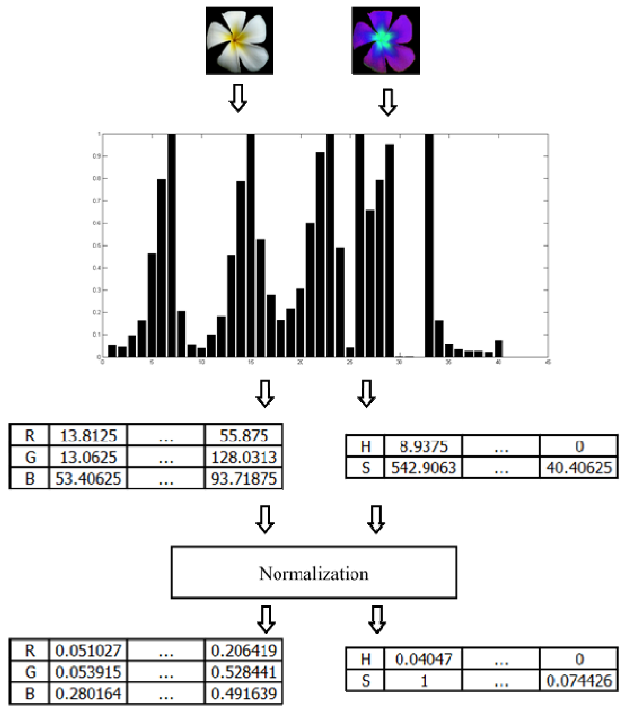

Fig. 7. Example of the color characteristics acquisition

The edge data discussed in the previous section will be used in Hu's seven-moment algorithm [10, 11] to obtain seven characteristic of the flower image.

Two-dimensional moments of a digitally sampled $M \times M$ image that has gray function $f(x, y), (x, y = 0, \ldots, M-1)$ is given as,

$$m_{pq} = \sum_{x=0}^{x=M-1} \sum_{y=0}^{y=M-1} (x)^p \cdot (y)^q f(x, y) \quad (2)$$

where $p, q = 0, 1, 2, 3, \ldots$

The moments $f(x,y)$translated by an amount (a, b), are defined as,

$$\mu_{pq} = \sum_x \sum_y (x+a)^p \cdot (y+b)^q f(x, y) \quad (3)$$

Thus, the central moments m'_{pq} or s μ_{pq} can be computed from (3) on substituting $a = -\bar{x}$ and $b = -\bar{y}$ as,

$$\bar{x} = \frac{m_{10}}{m_{00}} \text{ and } \bar{y} = \frac{m_{01}}{m_{00}},$$

$$\mu_{pq} = \sum_x \sum_y (x-\bar{x})^p \cdot (y-\bar{y})^q f(x, y) \quad (4)$$

When a scaling normalization is applied, the central moments change as,

$$\eta_{pq} = \frac{\mu_{pq}}{\mu_{00}^{\gamma}}, \gamma = \left[\frac{(p+q)}{2}\right] + 1 \quad (5)$$

In particular, Hu defines 7 values, computed by normalizing central moments through order three, that are invariant to object translation, scaling, and rotation.

An example of this technique is shown in Fig. 6. Each histogram of red, green, blue, hue, and saturation color spaces of color flower image after using graph cut is divided into 8 parts. The average of 32 data sets in each part is calculated. Then, all average values are normalized and finally 40 color characteristics are received. The example of color characteristics acquisition is shown in Fig. 7

D. Classification

All characteristic values from the previous section, which are 7 characteristics from edge information and 40 color characteristics will be classified by the K-nearest neighbor algorithm [12]. The three most nearest flower characteristics

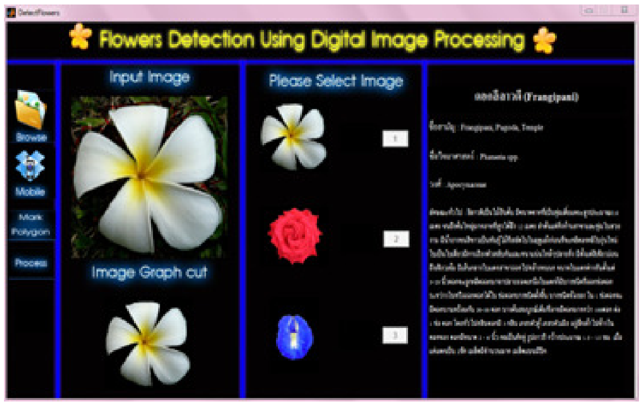

Fig. 8. GUI of the proposed system

are selected and shown in the GUI of the proposed system in Fig. 8. In addition, the most nearest flower information is displayed in the rightmost column in the designed GUI of the proposed system.

V. EXPERIMENTAL RESULTS

The proposed system is tested for 10 flower species. There are 50 test images for each species. This system uses 100 training images downloaded from [13]. The experimental results shown in table I. indicate that the accuracy of our system to be more than 80%. Two examples, red rose and butterfly pea, yield 100% accuracy because of their distinct color. Marigold has the least accuracy because its color set is similar to sunflower color set and its edge characteristic set is similar to globe amaranth edge characteristics.

TABLE I. THE EXPERIMENTAL RESULTS

Flower species	**% correction**
White plumeria 	90
Red rose 	100
Butterfly pea 	100
Purple lotus 	90
Orange cosmos 	96
Globe amaranth 	92
Chinese rose 	82
Marigold 	80
Periwinkle 	84
Sunflower 	86

VI. CONCLUSION

The flower recognition system based on image processing takes flower images from any smart phone or digital camera for analysis and identification. Therefore the system is highly mobile, and can be used 'in the field' by researchers and laymen alike. In the proposed system, the original flower image is resized for faster processing. To obtain only flower in the image, the graph cut algorithm and RGB to grayscale conversion is used. After the system receives edge characteristics by Hu's seven-moment algorithm and color characteristics, K-nearest neighbor is used to classify flowers. Our system shows the most nearest 3 flower images with matching flower information of the first nearest flower image. The accuracy of this system is more than 80%. This system can be further improved to yield more accuracy by combining other features, such as numbers of petals and flower texture. More flower species can be added to our system.

REFERENCES

[1] M. Das, R. Manmatha, and E. M. Riseman, "Indexing flower patent images using domain knowledge", IEEE Intell. Syst., vol 14, pp. 24-33, 1999.

[2] T. Saitoh and T. Kaneko, "Automatic recognition of wild flowers", System and Computer in Japan, vol. 34, no. 10, 2003.

[3] M. E. Nilsback, and A. Zisserman, "A visual vocabulary for flower classification", In CVPR, 2006.

[4] Y. Chai, "Recognition between a large number of flower species", Master thesis, University of Oxford, 2011.

[5] T. Sunpetchniyom, S. Watanapa, and R. Siricharoenchai, "Flower search by image on mobile phone", 2012 6th International conference on new trends in ISSDM, pp. 819-823, 2012.

[6] V. Vuarnoz, "Flower recognition", Semester project, École Polytechnique FÉdÉrale De Lausanne, 2010.

[7] "Dropbox", [online]. Available: https://www.dropbox.com/.

[8] Y. Boykov, and G. Funka-Lea, "Graph cut's and efficient N-D image segmentation", International Journal of computer vision, vol. 70, no. 2, pp. 109-131, 2006.

[9] J. Canny, "A computational approach to edge detection", IEEE trans. on pattern analysis and machine intelligence, vol. pami-8, no. 6, 1986.

[10] Z. Huang, and J. Leng, "Analysis of Hu's moment invariants on image scaling and rotation", Proceeding of 2010 2nd international conference on computer engineering and technology, pp. 476-480, 2010.

[11] R. Kasyauqi, C. P. Lee, and K. M. Lim, "Comparative study of Hu moments and Zernike moments in object recognition", Smart computing review, vol. 3, no. 3, 2013.

[12] T. Cover, and P. Hart, "Nearest-neighbor pattern classification", IEEE Trans. Inf. Theory, pp. 21-27, 1967.

[13] "Flower data set", [online]. Available: http://www.the-than.com, 2556.

[14] R. C. Gonzalez, and R. E. Wood, "Digital image processing", Prentice Hall, 3rd edition, 2007.

[15] R. C. Gonzalez, R. E. Wood, and S. L. Eddins, "Digital image processing using Matlab", Gatemark Publishing, 2nd edition, 2009.