Plant Species Identification Based on Otsu's and Edge Detection Techniques

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ABSTRACT – This study was conducted to obtain accurate confirmation of the leaves recognition. Pattern recognition of plants based on the leaves identification become a popular trend. Each leaf has its own identity that brings a lot of information that can be used to identify and classify the origin or type of plant. This paper proposes to determine the type of plants based on shape and veins by using Otsu and Edge Detection techniques. The main purpose of this paper is to ensure the chosen techniques are justified for plant classification. This study has tested six different types of leaf with five samples each, and the method yields accuracy greater than 90% in circularity and aspect ratio fields.

1. INTRODUCTION

Plants play an important role in various fields, such as food, medical science, industry, and environment as well as through a balanced ecosystem in the world. However many species are threatened and at risk of extinction due to environmental pollution caused by development reasons[1].

Leaf recognition is an importance part in plant recognition and usually, most of the plant had been recognize using the flowers or the fruits. The shape of the leaf and pattern of the vein can be used to differentiate of plant. According to [2], two features, which are widely used for plant recognition based on leaf image, are colour and shape. Research conducted by [3], described there are seven factors that affect the techniques used for image classification. The factors are based on the information as state in Figure 1 as below:

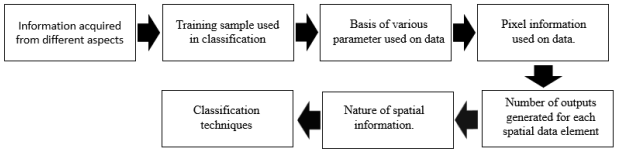


Figure 1 Factors affect techniques for image classification

There are six different techniques that been referred to such as k-NN Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, Principal Component Analysis and Fast Fourier Transform (FFT). Table 1 shows the authors and the techniques used in their research on plant classification. This research was focused on the leaf shape and vein extraction using Otsu's method and edge detection using Canny, Prewitt and Sobel. The technique has the advantages of the simplest classification technique, robust with regard to search space and no training required.

Table 1 Comparative Study on technique used

Classification Technique / Author	k-NN Classifier	PNN	Genetic Algorith	Support Vector Machine	Principal Compone nt	FFT
(Du et al 2007)	x	x			x	
(Kumar et al., 2011)	x	x		x		
(Wu et al., 2007)	x	x	x			x
(Lagerwall, 2011)		x			x	
(Kulkarni et al 2013)	x	x				

2. METHODOLOGY

Top-down approach is chosen in this study and it starts with the big picture. It breaks down from there into smaller segments. This methodology will include five phases which is Data Collection, Pre-processing, Processing, Analysis, and Accuracy. Figure 2 below shows the five phases involves in 'Top-down' methodology for this project.

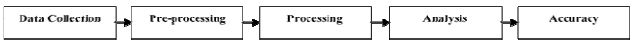
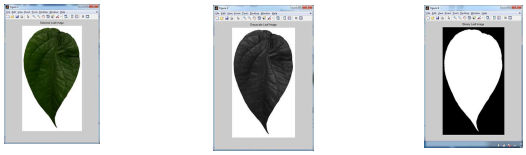


Figure 2: Process flow of 'Top Down' Methodology

There are six types of leaves are used for the purposes of this study. There are piper betel *(sireh),* hibiscus rosasinensis *(bunga raya),* eugenia aquea *(jambu air),* jasmine *(melor),* mariposa *(rerama)* and ocimum basilicum *(selasih).* Each leaf has different shape, surface and veins. It becomes an important identity to distinguish between leaves[4].

To find the selected leaf shape, the first step is to convert the RGB image to grayscale. For many applications of image processing, color information does not help in identifying important edges or other features. The next step is to threshold using Otsu method. It has been used to obtain six parameters such as maximum leaf length, maximum width, perimeter, area, circularity and aspect ratio. It has been combined with the vein extraction image so that the combination will make it more unique to each type of leaf. Figure 3 shows the images of every step taken in this process.

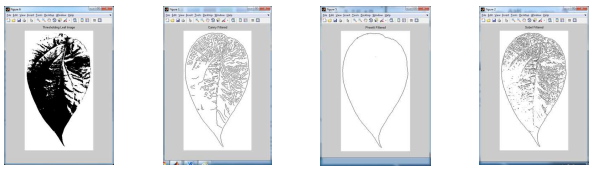


a. Load Image b. RGB- grayscale c. Otsu method

Figure 3 Steps to find the shape of the leaf

Apart from the shape, leaf vein extraction is also the main key point in this research as it is needed to undergo the process of the classification. There are three steps which had been used; Thresholding using Otsu's for shape detection, Edge Detection using Canny, Prewitt and Sobel Method for vein detection. The Otsu method is used to change the value of the threshold hence the vein image will be clearer and more dilate. The canny edge detection technique is used with low error rate, which means the detection should be accurate that it can get the edge as many as possible in an image.

The Prewitt operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical directions. The Sobel operator is used in image processing and computer vision, particularly within edge detection algorithms. It creates an image emphasizing edges. At each point in the image, the result of both Prewitt and Sobel operator are either the corresponding gradient vector or the norm of this vector. Figure 4 shows the images of end product of each technique.



a. Otsu b. Canny c. Prewitt d. Sobel

Figure 4 Techniques to find leaf vein extraction

3. RESULT AND DISCUSSION

The results obtained through experiments are shown in Table 2:

Table 2 Parameters of five piper betel

Sample	A	B	C	D	E
Length	496	392	391	421	349
Width	280	270	222	238	197
Area	88469	64741	55743	61489	42403
Perimeter	1316	1109	1052	1098	930
Circularity	0.6421 90641	0.6617 60656	0.6332 03768	0.6411 76183	0.6163 32854
Aspect Ratio	1.7714 28571	1.4518 51852	1.7612 61261	1.7689 07563	1.7715 73604

Based on Table 2, it is shown that six parameters of piper betel produced from five samples with different sizes of leaf. It was found that the circularity and aspect ratio is consistent for all samples of piper betel. Furthermore, this study carried out on five types of different leaf also shows a consistency on the circularity and aspect ratio.

The circularity formula is the ratio of 4*pi*area of the leaf to the square of perimeter and aspect ratio is the ratio between the maximum leaf length and the maximum width of leaf. From the table above, it appears that circularity and aspect ratio of five samples of every leaf is consistent. It can be concluded that the parameters obtained through the shape of a leaf can determine the type of leaf and it is more accurate when coupled with other feature such as leaf veins. Table 3 shows the average of circularity and aspect ratio for six types of leaves.

Table 3 Average of Circularity and Aspect Ratio

Leaf	Circularity	Aspect Ratio
Sireh	0.639	1.704
Bunga Raya	0.553	1.363
Jambu Air	0.490	3.438
Bunga Melur	0.748	1.672
Rerama	0.456	4.957
Selasih	0.510	2.268

4. CONCLUSION

The main objective of this study is to contribute to the society especially the botanist so they will recognize these plants in a short period of time. The study is focusing on the shape and veins features of the leaf to identify leaf through image processing. There are several additional works that can be done by the future researcher which they can find more suitable method to extract the vein.

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