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Weighting Facial Features Extraction using Geometric Average

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ABSTRACT

Human facial feature extraction is an important process in the face recognition system. The quality of the results from the extraction of human facial features is determined by the degree of accuracy. The weighting of human facial features is used to test the accuracy of the methods used. This research produces the process of weighting the facial features automatically. The results obtained are the same as those seen by the human eyes.

Keywords: Facial feature extraction, geometric, human face, weighting.

1. INTRODUCTION

Facial feature extraction is the main part of the face recognition system. In the extraction process the facial features distinguish features that exist on the face. Feature itself consists of the eyes, eyebrows, nose and mouth [1]. Humans can recognize faces quickly and accurately, but recognition with computers requires a relatively large amount of effort [2]. Therefore facial feature extraction process must be accurate in order to face recognition process becomes easier and faster.

Many research on feature extraction with various methods and algorithms, for example using genetic algorithms [1], eigenface [3], Smallest Univalue Segment Assimilating Nucleus (SUSAN) [2], Complex Dual-Tree Wavelet Transform [4], Gabor Filter [5], Active Shape Model [6] and Enhanced Active Shape Model [7]. Facial feature extraction can also be performed based on the position of the geometry of facial features [8]. The above studies produce varying degrees of accuracy, have their own disadvantages and advantages and also use techniques to calculate different levels of accuracy.

However, one of the problems in facial feature extraction is the calculation of the accuracy value. The accuracy of the feature extraction itself is influenced by image quality, if the image quality is poor, it will produce a small degree of accuracy.

The process of calculating accuracy in other studies using the Euclidean distance technique [9]. This technique compares the smallest difference between the result image and training image. The accuracy of this technique is influenced by the distance of the face on the image.

In this paper, we introduce a new weighting technique based on geometric position of human face characteristic. This feature weighting technique can be used to calculate the accuracy of the system.

2. FACIAL FEATURE WEIGHTING

Facial feature extraction aims to distinguish between the features that exist on the face so that the next process such as recognition process becomes easier. This study uses templates that utilize image edge segmentation results to get the facial features [1] as seen on fig.1 (a). Then the image of the facial features is emphasized and the areas not included from the facial features are ignored. This is done to simplify the process of weighting facial features, as seen on fig.1 (b) dan (c).

(a) (b) (c)

Fig.1. (a) Segmented image, Edge Strengthening for facial features (b) eye and mouth region (c) nose region.

Nose feature separated with other facial features in order not to be mistaken weighting process.

In the process of extraction of facial features, the facial region is assumed to be divided into three regions, namely the right eye area, the left eye, and the mouth [10]. The nasal region is determined after the three areas mentioned above have completed the feature extraction process.

3. PROPOSED METHOD

Weighting is one technique to calculate the accuracy of a software. In the case of facial feature extraction, the weighting will be given to the facial features.

The weighting of this feature is calculated using a rectangular template called the bounding box. This template has a different size in each region of facial features. Equation (1) is used to calculate the number of white dots within the bounding box.

$$w(x,y) = \frac{1}{m \times n} \sum_{i-x}^{m} \sum_{j=y}^{n} T(i,j) \quad (1)$$

The variable m and n are the widths of the feature area template. w(x, y) is also the coordinate point on the top left of a bounding box. T(i, j) is one if pixels in i, j are white and zero if they are black. The value obtained from equation (1) is stored, then the value is used for weighting the facial features with equation (2).

$$W = (w(x,y) \times 100) \div \max(w(x,y)) \quad (2)$$

The variable max(w (x, y)) is the most white point value within the bounding box of any image coordinates, or it can be assumed that max(w (x, y)) is the value of w (x , y) the highest of all coordinates. Weighted measures of facial features can be seen on fig.2.

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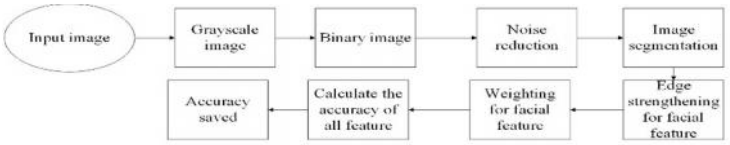


Fig.2. Weighting steps of facial features

After we get the weight value on each feature, the last step is to calculate the accuracy value of each facial feature with equation (3).

$$A = \frac{W(L\ ) + W(R\ ) + W(M) + W(N)}{4} \quad (3)$$

4. EXPERIMENT

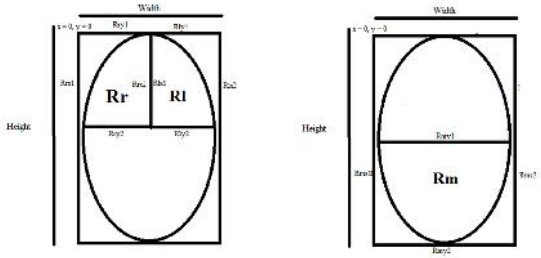
The image used is a secondary data that has been downloaded from the internet with an image size of 300x200 pixels. The edge detection process uses sobel operation and noise reduction using a median filter.

Image edge assertion is done manually with the help of photoshop application. The image edge assertion process is done according to human vision. Computers help in weighting the image in each image coordinate.

The image of edge assertion results is weighted using equation (2). Weighting process is performed on each region of facial features. Assuming the facial features are rectangular in size which can be seen on table 1 and fig. 3.

Table 1. Eyes and Mouth Region

	x1	x2	y1	y2
Left eye (Rl)	$\frac{w\ \ h}{2}$	$w\ \ h$	0	$\frac{he\ \ ht}{2}$
Right Eye (Rr)	0	$\frac{w\ \ h}{2}$	0	$\frac{he\ \ ht}{2}$
Mouth	0	$w\ \ h$	$\frac{he\ \ ht}{2}$	$he\ \ ht$



(a) (b)

Fig.3. (a) Eye Region and (b) Mouth Region

For the nose region is obtained after the eye and mouth region has been found. The nose region can be seen on table 2 and fig.4.

Table 2. Nose Region

	x1	x2	y1	y2
Nose (Rn)	0	$w\ \ h$	Rly2 (jika Rly2 > Rrly2) or Rry2 (jika Rry2 > Rly2)	Rmy1

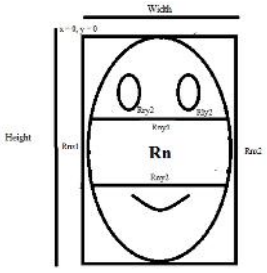


Fig.4. Nose Region

Table 3. Accuracy 100%

Ciri Wajah Manusia	w(x,y)	Max(w(x,y))	Weight	Ciri Wajah Manusia	w(x,y)	Max(w(x,y))	Weight
	288	288	100%		270	270	100%
	290	290	100%		200	200	100%

The bounding box for the eye area is assumed to be 80 x 50 pixels, for the nose area 60 x 20 pixels, and for the mouth area 85 x 40 pixels. The formation of the bounding box begins with determining the point of coordinates x and y first, then from that point created a rectangular bounding box with predetermined size..The weighting process is done on the left eye, right eye, mouth and nasal area. The more white dots inside the bounding box the greater the value of weight in the coordinates, with the weight range ranges from 0% to 100%. The first bounding box movement from the initial coordinate point in the left eye region, then ends until the bounding box touches the lower boundary of the left eye region. Next go to the right eye, mouth and nose area with the same bounding box movement as the movement in the left eye region. The results of this study can be seen in table 3.

5. CONCLUSION

The weighting of facial features can be implemented to test the accuracy of feature extraction systems. The weighting of facial features must be done carefully to produce the exact facial features as seen by the human eye. The results of this study are weighting the facial features automatically with the help of computers, with the same results as what is seen by the human eye. The use of this facial weighting technique can be used to research the extraction of other facial features based on the geometric position of the facial features.

REFERENCES

[1] G. G. Yen and N. Nithianandan, "Facial feature extraction using genetic algorithm," in *Proceedings of the 2002 Congress on Evolutionary Computation. CEC'02 (Cat. No.02TH8600)*, 2002, vol. 2, pp. 1895–1900.

[2] H. Gu, G. Su, and C. Du, "Feature points extraction from faces," *Image Vis. Comput. NZ Palmerst. North*, pp. 154–158, 2003.

[3] K.-W. Wong, K.-M. Lam, and W.-C. Siu, "An efficient algorithm for human face detection and facial feature extraction under different conditions," *Pattern Recognit.*, vol. 34, no. 10, pp. 1993–2004, 2001.

[4] T. Celik, H. Ozkaramanli, and H. Demirel, "Facial feature extraction using complex dual-tree wavelet transform," *Comput. Vis. Image Underst.*, vol. 111, no. 2, pp. 229–246, Aug. 2008.

[5] F. Y. Shih and C. F. Chuang, "Automatic extraction of head and face boundaries and facial features," *Inf. Sci. (Ny).*, vol. 158, no. 1–4, pp. 117–130, 2004.

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[6] K. Wan, “An accurate active shape model for facial feature extraction,” vol. 26, pp. 2409–2423, 2005.
[7] M. H. Mahoor and M. Abdel-mottaleb, “Facial Features Extraction in Color Images Using Enhanced Active Shape Model,” pp. 0–4, 2006.
[8] A. Gundu, H. Xrrm, N. Carolina, and S. Umversity, “Facial feature extraction using topological methods,” *Geom. Topol.*, vol. 7914, pp. 673–676.
[9] E. Winarno and W. Hadikurniawati, “Korelasi Jarak Wajah Terhadap Nilai Akurasi Pada Sistem Pengenalan Wajah Menggunakan Stereo Vision Camera ISBN : 979-26-0280-1 ISBN : 979-26-0280-1,” pp. 7–12, 2015.
[10] A. Nikolaidis and I. Pitas, “Facial feature extraction and pose determination,” *Pattern Recognit.*, vol. 33, no. 11, pp. 1783–1791, 2000.