New Algorithms for Detection of Expression in Mask Just For Laugh ("Dagelan") from Yogyakarta

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Abstract

This research needs to be held an expression introduction to the one of Yogyakarta's masks, which is Joking Mask, using Eigen value method. Joking Mask has many expressions such as neutral, happy, sad, and angry. The detection process is by reading mask image, color, and shape, taking an important feature from the mask expression, which is on lips. Then knowing the mask expression by comparing acquired Eigen value and Eigen value from the database, so the expression can be taken as a reference to determine the most wanted expression. By using the process above, the system can recognize the Yogyakarta joking mask expression with 70% of accuracy.

Keywords: *Mask, Eigen, Eigen face, expression detection*

1. Introduction

In Indonesia the mask initially is used as an instrument to communicate with the forefather soul, it can be seen on rituality. Mask is an instrument to visualize more abstract action in soul world [1]. The mask is often played in dance art performance. Didik Nini Thowok is one of Indonesia modern top performer playing up the mask tradition, from mask literal using to imitation gender metaphor mask [2]. The mask performance consists of some different segments; each consists of dialogue, song, comedy, drama, dance, and music [3]. The mask is often combined with a dance. This is the most complex art type in terms of drama and music [4]. Yogyakarta is a city that has various kinds of mask and dance. Dance offers great contribution on tourism development in Yogyakarta [5]. One of the masks of Yogyakarta is joking mask.

In the late of 20 years, the significant progress has been created to face recognition. But the various face patterns make it difficult to create the impressive and complex system so the algorithm used to detect that face [6]. Now the face recognition has been developed for many applications. The face usage as an identifier has many benefits, particularly on the practicability because it doesn't need to make a card or photo to the identification. The face expression plays important role in communication from emotional atmosphere and social interaction adjustment on human. They offer information regarding the category (such as happy, sad, fear, or angry) [7]. Beside face, the mask can be also used to be an identifier. By identifying the mask, so the expression can be seen. There are many techniques to reduce the dimension of image that will be proceed, one will be discussed here by using Eigen method.

Simple approach to extract information contained in face image is by catching the variation of face image collection, other than the feature appraisal, and using this information to codify and compare each image face [8]. Eigen face applies Principal

Component Analysis (PCA) to project the data point throughout the maximal variation direction. Eigen face is better than the other methods because it has a capability to do self-learning and then recognize the new faces [9]. Although it is not an elegant solution to face recognition problem, the Eigen face approach provides well practical solution to this face recognition problem. This method is fast, simple relatively, and well-proven in limited environment [10, 11]. This is one of methods that can be classified as a method based performance, using all face area as an input to the recognition system [12].

2. Mask

Mask is an object familiar with human life by a long period, since pre-history era until now. It is also universal, almost in entire world to know the mask. The mask material has some variations, from metal (gold, silver, and bronze), wood, leather, clay, and rock material. The colorful paintings on someone's face, according to the professionals it is categorized as a mask. It means that mask is always linked to the function as a face cover, for different reasons, from religion, sociological, with art and performance.

Mask is stuff wore in the face. It is usually worn to accompany the local art music. The mask in local art is commonly to respect the worship or explain character in accompanying the art. The mask shapes is various, such as angry, soft, and also reflects wisdom. The mask has been one of the oldest expression figuration that has been ever created by human civilization. On most of people in the world, the mask holds important role in many life sides that keep magical and pure values. This is because of the major role as special symbols in noble rituality and activities. The modern society life today places the mask as one of high level swan songs. It is not only because of its aesthetic, but the mystery side on mask face shape has a capability to shed the magical power.

3. Eigen Face Algorithm

In Eigen face method, image series (training set) are represented as a vector. The Eigen face idea is to find out the lower-dimension space where the short vector will reflect the face. But the various patterns make difficulties to create a strong face recognition system and a complexity of algorithm that is hard to apply [6]. The Eigen face method is stronger and more effective to recognize the face [13]. It is so efficient and already received largely and we propose the request for this application [14]. This can be conducted by applying PCA to count the eigenvector from face image sample. Eigenvector is called Eigen faces acquired from sample of the face image [15].

To extract the feature, we use a well-known technique called Principal Component Analysis (PCA), known by Eigen face for face recognition [16]. The first processing of two dimension image needs to be served. The objective is to speed the performance and reduce the memory capacity used to three dimension recognition. The first processing is served by extracting the image characteristic of N-dimension M where M<N. The two-dimension image three dimensions object with different point of view is recognized to be collected to represent the object as a reference image. The feature extraction is served on set of characteristic for information object. The result then is used to feature extraction process of three dimension object recognition. Eigen value and vector can be understood well if it is seen in physical problem side. For example if there are elastic membrane two-dimension reflected on x and y coordinate, the membrane obtains the physical treatment that can emphasize, draw, and spun from the beginning position. If it is served, after the deformation initial point on membrane area (x, y) that changes the position to be (X, Y) and we can say that there is matrix M reflecting the deformation curve. The position

vector change can be called as R = μr = μ constant where the vector R as Eigen vector and μ is called Eigen value of matrix M transformation.

To illustrate the Eigen value determination, review a linear transformation curve in two-dimension.

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} 5 & -2 \\ -2 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

From the condition Eigen vector R= μr, that can be symbolized as:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} 5 & -2 \\ -2 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \mu \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \mu x \\ \mu y \end{bmatrix}$$

Or it can also be written as:

$$(5- \mu)\, x-2y = 0$$

$$-2x+(2- \mu)y = 0 \qquad (1)$$

If the problem is solved as homogeneous equation type with the determinant, then results x=0 and y=0. There is an exception if the determinant of coefficient is equal as 0, then the Eigen value is μ=1 or μ=6 and Eigen vector results 2x-y=0 and x+2y=0, as showed on Figure 1.

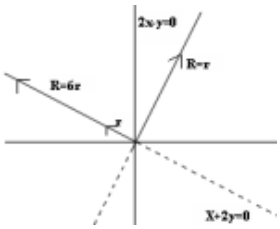


Figure 1. Physical Interpretation of Eigenvalues and Eigen Vectors

Interpretation of the curve is Eigen value of transformation matrix offers information how great the area deformation, while the Eigenvector of transformation matrix offers information about that area deformation change.

4. Approach with Eigen face Algorithm

The Eigen face algorithm is modification of Eigen face algorithm created by M. Turk and A. Pentland [11]. The face taken by M. Turk and A. Pentland is entire face but this research only takes lips of the mask. This is chosen because lips of the mask have characteristic to determine that mask expression. Then the modification is when capturing the image that Eigen value will be counted, that is capturing lips of the mask.

The proposed algorithm will compare the eigenvalues of a picture being investigated with eigenvalues images on the database. Mask image in the database that have the greatest similarity is used as a reference to determine the expression of the image.

The steps of the algorithm are divided into two parts:

a. Calculate the eigenvalues of the database (Figure 3):

1. Read the image and convert the image to a database in the form of a matrix.

   Detect and take the lip on each image in database

The detection is done by detecting lips red in the image. This is done because the lip on the mask slapstick always red. But an eyebrow on the mask is also often colored red, the red areas with the largest being detected as a lip on the mask. Lip strip making process is shown in Figure 2.

Figure 2. The Process of Taking the Lip Area

2. Calculate the eigenvalues of the areas that have been detected as an edge for each image in the database.

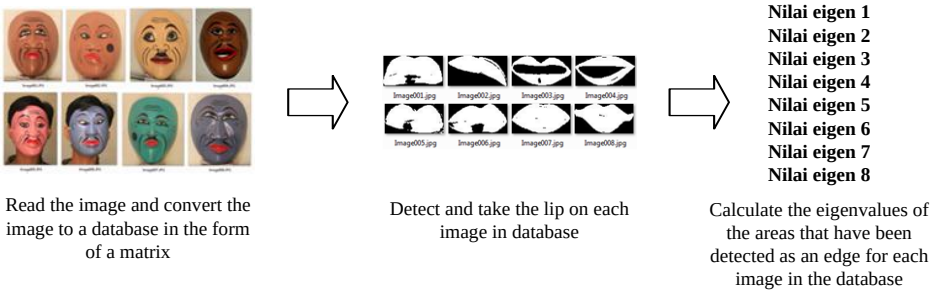


Figure 3. The Process for Calculating the Eigenvalues of the Data Base

b. Calculate the eigenvalues of the database (Figure 4):

1. Reading an image mask to be detected and turn the picture into matrix form.
2. Detect and take the lips in the image is detected.
3. Counting eigenvalues in regions that have been taken as the lips in the image is detected.
4. Comparing the eigenvalues of the image detected by the eigenvalues of every image in the database. Drawing on a database that has the eigenvalues close to or equal to the eigenvalues of the image is detected, it will be used as a reference to determine the expression.
5. Determine the expression of the image to be detected on the basis of data.

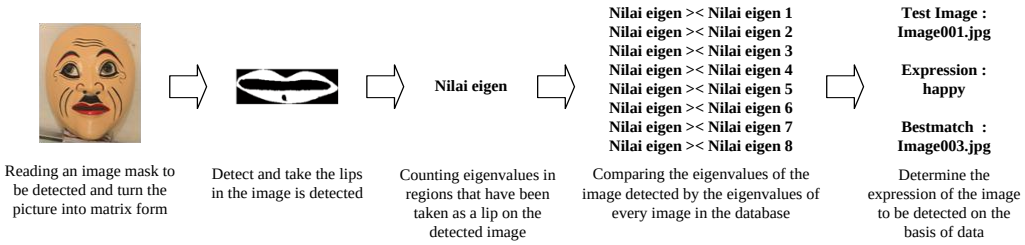


Figure 4. Expression Detection Process

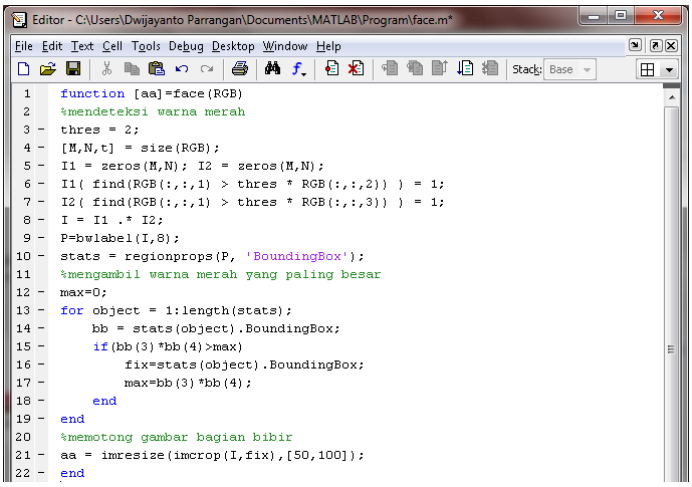
5. Experiment

For the database, use 8 masks with "Jpg" format and they have different dimension or size Figure 5 shows 2 images for sad expression, 2 for happy, 2 for anger, and 2 for neutral.

(a) (b) (c) (d)

Figure 5. Pictures for Sad Expressions (a), Happy (b), Angry (c), and Neutral (d)

Then detect and take the lips by using the face as showed on Figure 6, acquiring lips image on Figure 7, and counting the Eigen value.



```
function [aa]=face(RGB)
%mendeteksi warna merah
thres = 2;
[M,N,t] = size(RGB);
I1 = zeros(M,N); I2 = zeros(M,N);
I1( find(RGB(:,:,1) > thres * RGB(:,:,2)) ) = 1;
I2( find(RGB(:,:,1) > thres * RGB(:,:,3)) ) = 1;
I = I1 .* I2;
P=bwlabel(I,8);
stats = regionprops(P, 'BoundingBox');
%mengambil warna merah yang paling besar
max=0;
for object = 1:length(stats);
    bb = stats(object).BoundingBox;
    if(bb(3)*bb(4)>max)
        fix=stats(object).BoundingBox;
        max=bb(3)*bb(4);
    end
end
%memotong gambar bagian bibir
aa = imresize(imcrop(I,fix),[50,100]);
end
```

Figure 6. Print Screen to Take the Lip Area Code

(a) (b) (c) (d)

Figure 7. The Lip Area for Sad Expressions (a), Happy (b), Angry (c), and Neutral (d)

The experiments image will be detected in "Jpg" format and have dimensions or various sizes (Figure 8).

Figure 8. The Images will be Detected

Then detect and take the lips by using the face as showed on Figure 6, lips image on showed on Figure 9, and counting the Eigen value.

Figure 9. Lip Area on the Image to be Detected

Furthermore, compare the Eigen value of the image detected by Eigen value from each image in database. Images in database that possess nearest Eigen value from the detected images will be used as reference to determine the expression. Expression determination is based on file LabelFile.txt. LabelFile.txt saves file name and expression of each image in database (Figure 10).

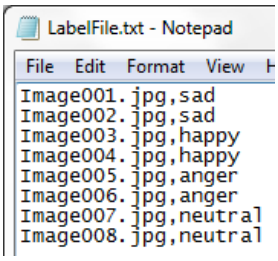


Figure 10. Fill LabelFile.txt

Based on algorithm above, the result of expression detection will be saved in result.txt. File result.txt contains names and expression detection results from the detected images, and image names on database that the Eigen value is close to Eigen value of detected image (Figure 11).

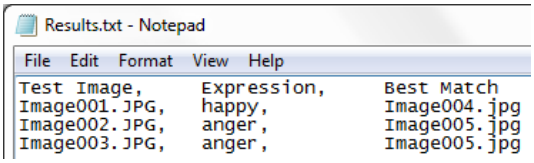


Figure 11. Expression Detection Results

The research is committed by using MATLAB (matrix laboratory), as showed on Figure 12.

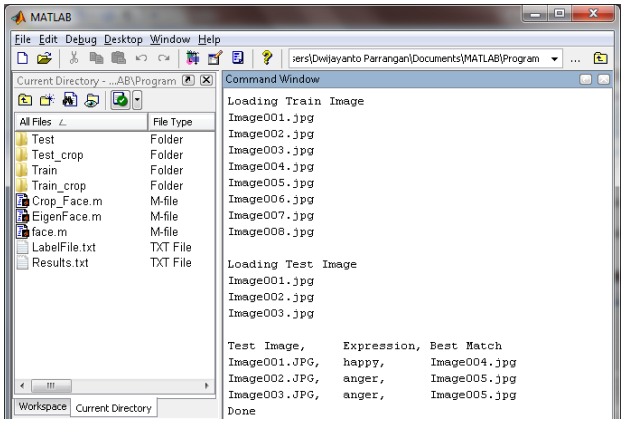


Figure 12. Print Screen Code Display the Experiment in MATLAB

6. Conclusion

In this research shows that the algorithm of Eigen method approach can be used to detect the joking mask expression of Yogyakarta with 70% of accuracy. The input uses mask image in "Jpg" format. To increase the expression detection accuracy is by adding the number of image in database. So, if there are many images in database then the detection results will be more accurate.

For the next experiment, we will try to make eyes detection on mask. So, considering of eyes and lips shape are expected to be a more accurate expression detection.

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