Minangkabau and Sunda Tribes Detection Based on Lip Print Pattern Using Discrete Cosine Transform (DCT) and Learning Vector Quantization (LVQ)

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Abstract—Forensic science is one of the medical sciences to be able to express the identity of an individual from gender to race and ethnicity. In general, forensic science can be interpreted as an application or use of certain knowledge in the interests of law enforcement and justice. In an individual there is a unique pattern that is different from other individuals, even though the specifics will be different for each individual. In general, fingerprints are used but have limitations, namely the lack of resistance to the fingers so that another alternative is lip prints. Lips are an alternative way to get data from individuals. On the lips there are unique patterns that each individual is different, namely the description of sulci on the mucosa of the upper lip and lower lip, as well as fingerprints. Lipstick can be used so that it can help forensic science in solving existing cases. This Paper to identify the Minangkabau and Sundanese tribes so as to minimize the scope of individual searches in the application of forensic science. The method used is the registration of lip print images By using feature extraction method of Discrete Cosine Transform (DCT) and and for classification using Learning Vector Quantization (LVQ).

I. INTRODUCTION

The definition of forensic odontology is a branch of science of judicial dentistry that aims to apply dental knowledge in solving legal and crime problems [1]. The lip pattern is unique for each individual examined, even in twins and different families [2].

Individual identification takes quite a long time so that here the writer conducts research to be able to minimize the scope of the search by grouping Minangkabau and Sundanese so that it reduces the scope of individual searches in the field of forensic science.

From the above problems, the authors created a system that can identify lip print patterns using digital image processing using the *Learning Vector Quatization* (LVQ) method, image registration Discrete Cosine Transform (DCT) as the feature extraction method selected by total sampling.

II. SYSTEM MODEL

A. System Planning

The flow to get the lip print pattern is through several stages including, inputting digital images or image acquisition, then increasing image quality by using pre-processing, the process then performs feature extraction using Discrete Cosine Transform (DCT). after that the feature will be detected using the Learning Vector Quatization (LVQ) classification method. The data used for analysis contained 116 data, 58 Sundanese lips prints and 58 Minangnese lips prints, from which we will be classified according to their respective tribes, Sunda and Minang.

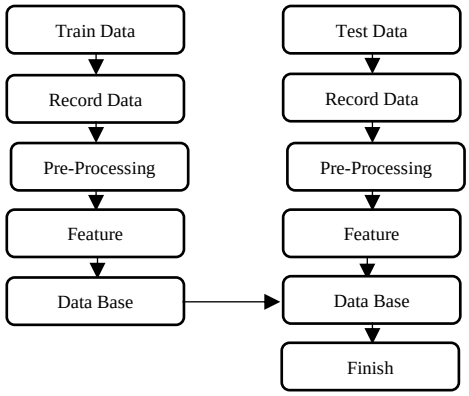

Fig. 1. The following is the network architecture of Learning Vector Quantization (LVQ)

B. Basic Concept of Digital Image

RGB images have 3 color channels namely red channel, green channel, and blue channel. In 24-bit RGB, each channel has pixel intensity with 8-bit depth, meaning that color variations have 2 ^ 8 = 256 degrees of color (0 d.d 255). At each RGB pixel there is an intensity value which is a combination of the values of R, G, and B. Color variations of each pixel for RGB images are 256 x 256 x 256 = 16,777,216 [7].

Second, grayscale image is an image whose pixel intensity value is based on the degree of gray. The number of bits in grayscale is 8 bits or there is 1 byte, so the number of colors is 2 ^ 8 = 256, the value is in the range 0-255. So that the intensity value of the gray image will not exceed 255 and will not be less than 0. The storage model is f (x, y) = intensity value, with x and y representing the intensity value position [8].

C. Classification of Lipstick Patterns

Research and information on research on the use of lip prints as a personal proof of identification and criminal investigation in dentistry [3]. The following classification of Suzuki and Tsuchihashi can be seen in Figure 2.1[4].

Type I: A clear-cut groove running vertically across the lip.
Type I′: Partial-length groove of Type I.
Type II: A Branched groove.
Type III: An intersected groove.
Type IV: A Reticular pattern.
Type V: Other patterns.

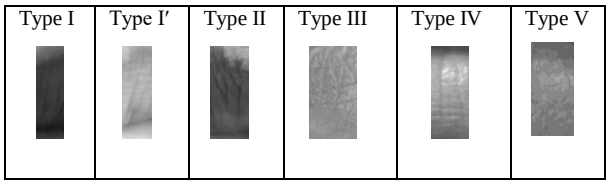

Fig. 2. 6 types of lips and will be a reference to be able to determine the type of Sundanese or Minang lips

D. *Discrete Cosine Transform* (DCT)

DCT-2D is the development of DCT-1D, then the transformation from the spatial domain to frequency using the discrete DCT-2D method can be expressed in the form of equations:

$$C(u,v) = \frac{2}{\sqrt{M.N}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y) \cos\left[\frac{\pi(2x+1)u}{2N}\right] \cos\left[\frac{\pi(2y+1)v}{2N}\right] \quad (1)$$

For u, v = 0,1,2, ..., N-1 has been defined in figure (1), for the inverse of the transformation can be written in the form of the following equation:

$$f(x,y) \quad = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} \alpha(u)\alpha(v)C(u,v) \cos\left[\frac{\pi(2x+1)u}{2N}\right] \cos\left[\frac{\pi(2y+1)v}{2N}\right] \quad (2)$$

DCT has advantages, that is, the average time of DCT-2D extraction does not depend on the number of features extracted[5].

E. *Learning Vector Quantization* (LVQ)

LVQ is a method of classifying the pattern of each output unit representing a particular category or class (some output units should be used for each class) [6].

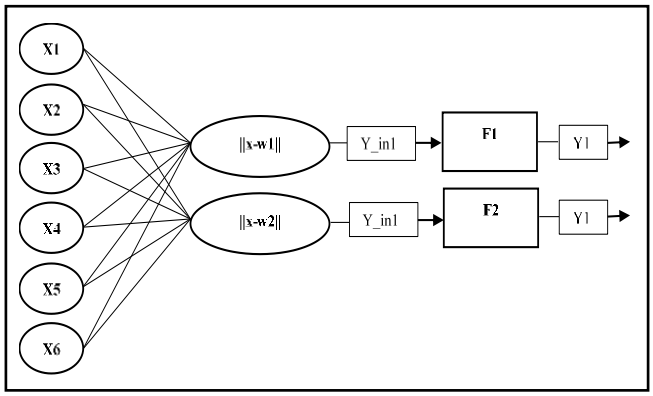

Fig. 3. The following is the network architecture of Learning Vector Quantization (LVQ)

Information:

1. X1 to Xn = input value
2. || Xi-Wi || until || Xn-Wn || = weight distance
3. F1 to Fn = output layer
4. y1 to yn = output value
5. n = number of words (number of classes)

The advantage of the LVQ method is its ability to provide training to competitive layers [6].

III. ANALYSIS

Analysis in classifying Sunda and Minang tribes using several parameters contained in extraction and classification so as to influence the results of accuracy and computational time on classification, namely block size, statistical characteristics, hidden layer, and epoch, along with analysis of each existing parameter.

A. *Block Size*

Block size analysis, we are using 3 of their values 4, 16 and 64. The following table from the results of the Block size analysis :

TABLE I. The Result Of Block Size Analysis

No	***Block Size***	***accuracy***	***computational time***
1	4	83,62	857,96
2	16	87,06	87,98
3	64	81,03	32,35

Analysis of Statistical Characteristics using some of their parameters are mean, standard deviation. skewness, kurtois, and entropy. The analysis that has been done is shown in the following table:

TABLE II
The Result Of Statitical Charateristic Analysis

No	***Statistical Characteristics***	***accuracy***	***computational time***
1	Mean	87,06%	87,98
2	Standar Deviasi	87,06%	95,12
3	Skewness	52%	117,04
4	Kurtosis	54%	82,07
5	Entropy	41,37%	117,68

TABLE III
The Result Of Statitical Charateristic Analysis with combination 2 Statitical Charateristic

No	***Statistical Characteristics***	***accuracy***	***computational time***
1	Mean, Entropy	88,79%	98,23
2	Standar Deviasi, Kurtosis	82,75%	84,48
3	Skewness, Kurtosis	45,68%	118,56

TABLE IV
The Result Of Statitical Charateristic Analysis with combination 3 Statitical Charateristic

No	***Statistical Characteristics***	***accuracy***	***computational time***
1	Mean, Standar Deviasi, Skewness	87,06%	83,76
2	Standar Deviasi, Skewness, Kurtosis	82,75%	123,08
3	Skewness, Entropy, Mean	87,93%	85,53

TABLE V
The Result Of Statitical Charateristic Analysis with combination 4 Statitical Charateristic

No	***Statistical Characteristics***	***accuracy***	***computational time***
1	Mean, Standar Deviasi, Skewness, Kurtosis	87,06%	83,76
2	Mean, Skewness, Kurtosis, Entropy	64,65%	130,26
3	Standar Deviasi, Skewness, Kurtosis, Entropy	82,75%	123,15

TABLE VI
The Result Of Statitical Charateristic Analysis using all of Statitical Charateristic

No	***Statistical Characteristics***	***accuracy***	***computational time***
1	All	83,62%	95,73

B. Hidden Layer

Hidden layer values that we are using, there are 10, 30, and 50. the results of analyzing hidden layers can be seen in the table below :

TABLE VI
The Result Of Hidden Layer Analysis

No	***Hidden Layer***	***accuracy***	***computational time***
1	10	76,72%	83,43
2	30	91,37%	83,67
3	50	88,79%	90,21

C. Epoch

Epoch analysis, we are using 3 of their values 200, 300 and 400. The following table from the results of the Epoch analysis:

TABLE VII
The Result Of Epoch Analysis

No	***Epoch***	***accuracy***	***computational time***
1	200	88,79%	83,43
2	300	87,93%	83,87
3	400	91,37%	84,26

IV. CONCLUSION

From the results of testing and analysis that has been done on the identification system of lip print patterns in human identity, conclusions can be taken as follows:

1. The design and realization of the system to identify lip print patterns in human identity using the Discrete Cosine Transform (DCT) method and the Learning Vector Quantization (LVQ) classification of the data obtained has been successfully performed.
2. The system can detect all lip print patterns in the Suzuki and Tsuchihashi classifications of 91.37%.
3. Can know the parameters that can provide the best accuracy results in identifying lip print patterns in human identity, namely Block Size 16, Mean and Entropy Statistical Characteristics, Hidden Layer 30 and Epoch 400 values.
4. The best performance obtained from all tests is an accuracy of 91.37% with a computation time of 98.23 seconds, in the condition of 106 lips images identified according to the Sunda and Minang tribes. Meanwhile, the other 10 identified do not fit the Sundanese and Minang tribes.

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