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ANALYSIS OF FACE RECOGNITION USING VIOLA JONES ALGORITHM AND MODIFIED SELF ORGANIZING MAP

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ABSTRACT

This study aims to determine the effect of face recognition method with Viola-Jones algorithm and cosine similarity method in determining initial weights and cluster formation on SOM networks, so as to improve the accuracy of learning self-organizing map (SOM) networks for face recognition. The data used for this research is in the form of face images taken from internet pages with the address: https://cswww.essex.ac.uk/mv/all-faces/fa-ces94.html, with an image size of 180 pixels x 200 pixel. The images studied were 1000 images with a total of 50 types of facial images and a sample of 20 images for each face. The comparison between training images and test images is 60:40. Where training images are used as many as 600 images and as many as 400 imagery test images. Face recognition using the SOM method obtained an accuracy of 90% for the network training process and a network testing process of 87.75%. Whereas for facial recognition using modified SOM, the results of facial recognition were 95.67% for the network training process and 94% for the network testing process. It can be concluded that the process of facial recognition using the Modified SOM method has a good percentage of accuracy for facial recognition.

KEYWORDS: ***face recognition, face detection, viola jones algorithm, modified self orginizing map***

1. INTRODUCTION

Self-organizing map (SOM) is one type of artificial neural network with unsupervised learning. The key idea of this approach is to map data input space and calculate its proximity value based on predetermined weights that are commonly used for data clustering techniques. The smallest distance data will be used as the closest neighbor and weight changes will be made. Face recognition requires image input and involves image processing, considering the values of the extracted characteristics found in the image. Before this procedure is carried out, the image detection process will be carried out using the Viola-Jones algorithm, so that the input face image will only take on the characteristics of the face and will then be used as a network input. This is required because the background of the face has some patterns that can affect the output of the facial image extraction feature, so that the use of the Viola-Jones algorithm only generates facial images for identification purposes.

Many studies have shown that when the selection of initial weights is not appropriate in a self-organizing map (SOM) network, the results are less than optimal to minimize the level of accuracy of the face recognition. Some equations can be used in a self-organizing map (SOM) network to measure the distance between input nodes and weights in a network other than Euclidean distance for measuring data similarity, i.e. cosine similarity. Cosine similarity is a method used to calculate the degree of similarity in the data**Objective of the study**

This study aims to determine the effect of face recognition method with Viola-Jones algorithm and

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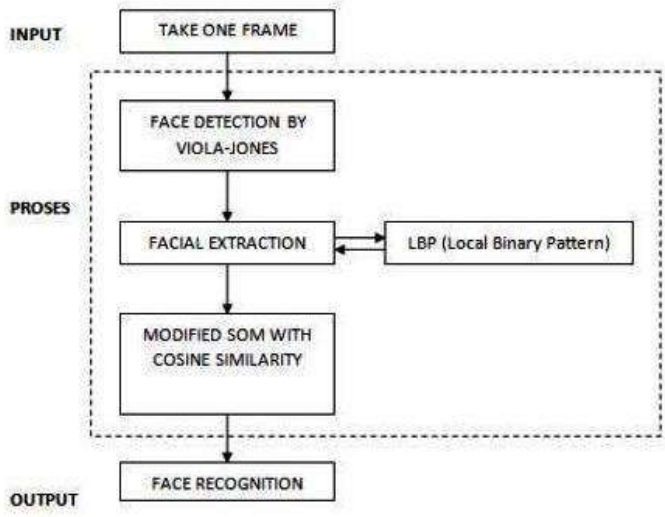
cosine similarity method in determining initial weights and cluster formation on SOM networks, so as to improve the accuracy of learning self-organizing map (SOM) networks for face recognition

2. RESEARCH METHODOLOGY

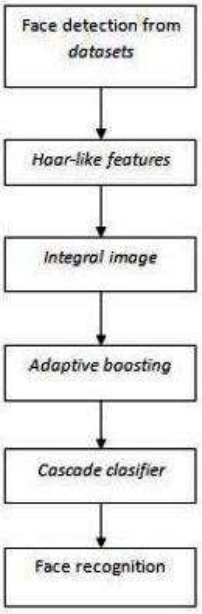
The data used for this research is in the form of face images taken from internet pages with the address: https://cswww.essex.ac.uk/mv/all-faces/fa-ces94.html, with an image size of 180 pixels x 200 pixels. The images studied were 1000 images with a total of 50 types of facial images and a sample of 20 images for each face. The comparison between training images and test images is 60:40. Where training images are used as many as 600 images and as many as 400 imagery test images. The methodology used in this study, namely:

1. Conduct testing of training data using artificial neural networks self organizing map. Before entering the network, first look for initial weights using the cosine similarity method. This method will look at the proximity of the image data in each class to obtain the image data with the highest similarity and is determined as the initial weight. Initial weights will be entered into the network and produce the final weights that will be used for the testing process.
2. Analyze the use of a self-organizing network map method with cosine similarity for facial recognition. The level of accuracy between the proposed methods of network modification will be compared with the network model without modification. Following that, the highest level of accuracy is seen between the two methods.
3. Summing up the effect of using the cosine similarity method on the network self-organizing map in the selection of network initial weight data, whether it can improve the accuracy of facial recognition or the same as the results of facial recognition using a self-organizing map network without modification.

The following are the steps on face recognition using the Viola-Jones algorithm and the modified self-organizing map network, namely:



Face Recognition Process with Viola-Jones Algorithm and Modified SOM



Face Detection with Viola-Jones Algorithm

Figure 1

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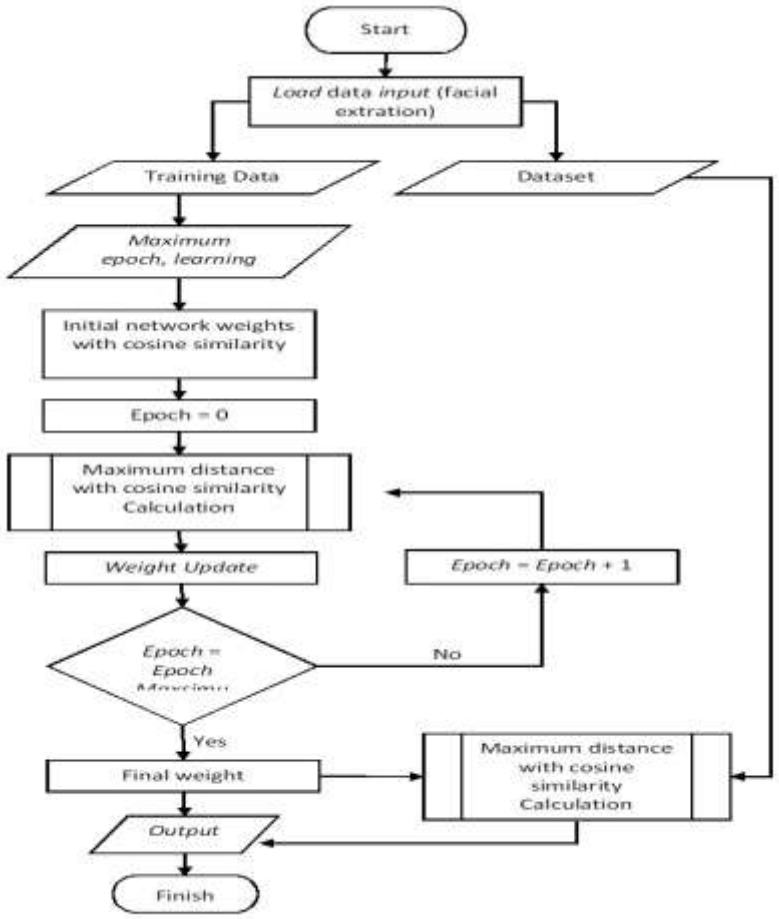

Figure 2

Calculation of the algorithm using the Local Binary Pattern (LBP), a binary code that is represented as a pattern generated by the grayscale process in the image. Self Organizing Map (SOM) is used to determine the results of the classification of data or the classification of face images using the SOM network. Testing is carried out using a computer with hardware and software specifications as follows:

1. Processor Intel Pentium Core i3.
2. RAM 4 GB.
3. Harddisk 500 GB.
4. Matlab R2015b.

3. LITERATURE REVIEW

Face recognition is the process of identifying unknown face images with computational algorithms and comparing them to existing face data (Singh & Singh, 2013). Face recognition has three phases, namely: face detection, feature extraction, and face image classification (face recognition).

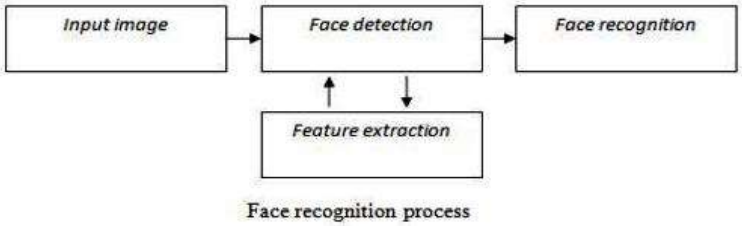

Figure 3

Face detection is the first step provided by the facial recognition system to retrieve data based on the characteristics of the facial member attributes. Viola-Jones algorithm is the most commonly used method for detecting faces with relatively fast, accurate, and efficient image performance. Viola-Jones algorithm

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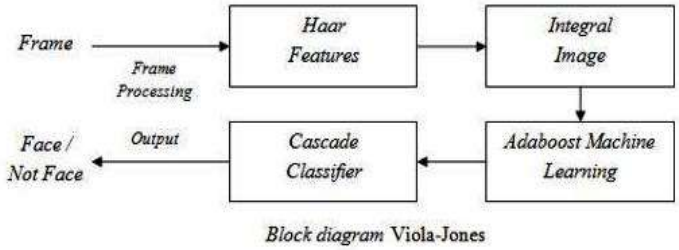
process can be seen in Figure 4 below (Raya, et al., 2017).



Block diagram Viola-Jones

Gambar 4

The face detection step with Viola-Jones algorithm is as follows (Syafira & Ariyanto, 2017).

1. Haar-like feature
2. Citra Integral
3. Ada-Boost
4. Cascade Classifier

Image Extraction is the method of extracting features or information from objects in the image that you want to identify or differentiate from other objects. The facial recognition feature extraction process in this study can be performed based on the texture value in the image that is generated from the texture feature extraction process using the LBP (Local Binary Pattern) method. Local Binary Pattern is a non-parametric operation used to describe the local spatial structure of the image.

SOM is a technique for the analysis of high-dimensional input data that are unsupervised neural networks. SOM will determine the similarity of characteristics between data groups within the same cluster (Oja & Kaski, 1999). The steps taken in the clustering and classification phases using the SOM network can be described as follows. (Lumchanow & Udomsiri, 2017).

1. Initialization of initial weights chosen randomly
2. Set the epoch value and learning rate (α).
3. Prepare training data (input vectors) from the dataset.
4. Calculates the proximity of distance (dij) between input vectors and weights (wij) at each node.
5. Perform an update (change in weight) at the closest value based on the BMU value and make changes to the learning rate (α).
6. Perform further calculations as in phase 4 based on the specified number of epochs. Network learning will be stopped until the maximum epoch value is reached.

*C*osine similarity is a measure of the similarity between two vectors derived from the cosine angle values based on the comparison of these vectors. The application of the cosine similarity method is useful in classifying data on the number of objects having certain similarities as a grouping of studies based on the cosine similarity measured.

4. RESULT

SOM Network Learning Accuracy Testing Results on Face Recognition

This test was performed to determine the accuracy of facial recognition using the SOM network. Face images obtained both the training image and the test image will be processed using the Viola-Jones algorithm to get the right part of the face. After that, face recognition will be performed with the SOM network. In this network, the initial weight will be determined randomly and selected data from 12 test data in each image class. The total weight chosen was 50 data because the data classes in this study were 50 classes. Weights can be chosen from the data because the range of weight formation values is still met.

The training accuracy obtained from each face recognition experiment with random weights can be seen in Table 1 as follows.

Tabel 1
SOM Network Training Accuracy

Descrption	Experiment I	Experiment II	Experiment III
True data	540	538	537
Accuracy	90%	89.67%	89.50%

Based on the experiments that have been done, the highest test scores obtained in Experiment I. This shows that the weight used in Experiment I is better than the weight in other experiments. Producing the weight released for the testing process is the final weight generated in experiment I. Furthermore, the weight in experiment I will be included in the network to obtain the required final

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weight will be useful for the SOM network testing process on face recognition.

The testing process is performed to determine the accuracy of the face recognition of the new face image input. This process is extracted from the calculation of the final weight of the new input image data. The minimum distance calculation uses Euclidean equations on the SOM network to determine which class the new image input belongs to. The test images used in this study were 400 images with 50 data classes. The findings of face recognition using a random weight SOM network can be seen as follows in Table 2.

Table 2
SOM Network Testing Results

Description	Testing Image
Total data	**400**
Total of true data	351
Accuracy	87.75%

From table 2 above, we can see the accuracy of the SOM (Self Organizing Map) network testing for face recognition. The epoch determined in the network learning process is 100 and alpha (α) is 0.01 with a reduction of 0.5. Testing accuracy obtained by 87.75% with the correct amount of data as many as 351 of 400 data. The program display with the parameter settings mentioned can be seen in Figure 5 as follows.

Figure 5
Face Recognition Accuracy with SOM Networks

Input image in the form of the face image in the testing process first search feature extraction values using the LBP (Local Binary Pattern) method like the previous training image. The value taken for each test image is the same as the training image, which is the value of the image texture features with a total of 59 character values or features. The results of testing each individual in the program for facial recognition can be seen in Figure 6 as follows.

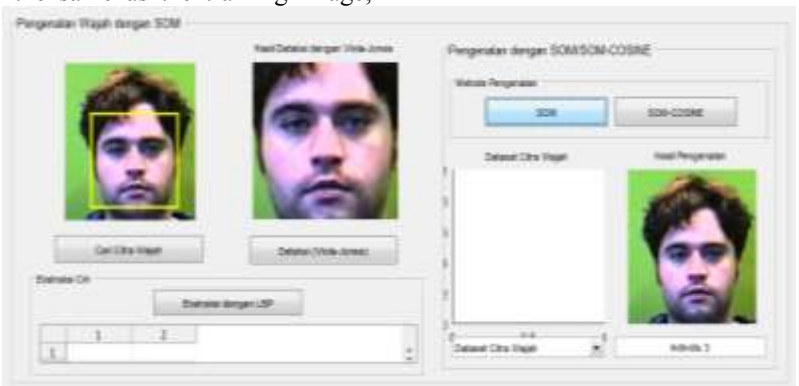

Figure 6
The Recognition Process in New Imagery with the SOM Network

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Introduction results for each data class consisting of 8 test images can be shown as a whole in Figure 7.

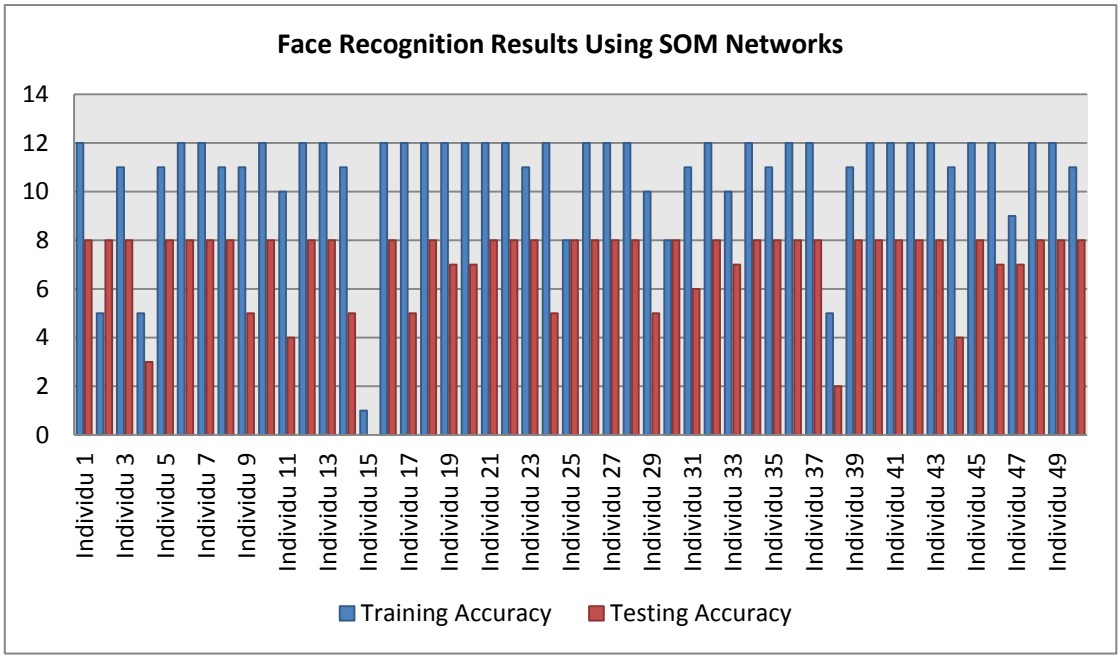

Figure 7
Face Recognition Results in 50 Individuals Using SOM network

SOM Network Accuracy Test Results Using Cosine Similarity in Face Recognition

This test is performed to determine the accuracy of face recognition using a modified SOM network for the determination of initial weights and the equation for the determination of class data using cosine similarity. The resulting image will be determined using a texture extraction feature using the LBP (Local Binary Pattern) process. This value is used as an input to the SOM network that will be learned to get the final weight. Before entering the network, the data in each image class is chosen to be used as the initial weight of the network chosen using the cosine similarity equation. The data trained on the SOM network consists of 600 images and each class consists of 12 data / images. Using the cosine equation, the level of similarity of images with the highest similarity can be determined as the initial weight of the SOM network.

Testing is carried out to determine the accuracy of facial recognition of new data or new face image input. This process is generated from the calculation of the final weight of the new input image data. Calculation of the maximum distance using the cosine equation on the SOM network, which determines which class of new data or new image input, is grouped together. The training images used in this study were 600 images with a total of 50 data classes. While there were 400 images with a total of 50 data classes for the testing process. Results of face recognition using the SOM network use cosine similarity for the determination of initial weights or SOM modifications as shown in Table 3 below.

Table 3
Modified SOM Network Test Results for Face Recognition

Description	Training Image	Testing Image
Total data	600	400
Total true data	574	376
Recognition Accuracy	95.67%	94%

A comparison between the accuracy of the training and the accuracy of the SOM modification network testing for face recognition can be seen from Table 3 above. The epoch determined in the network learning process is 100 and alpha (α) is 0.01 with a reduction of 0.5. Testing the program with the parameters defined in the SOM modification network can be seen as follows in Figure 8.

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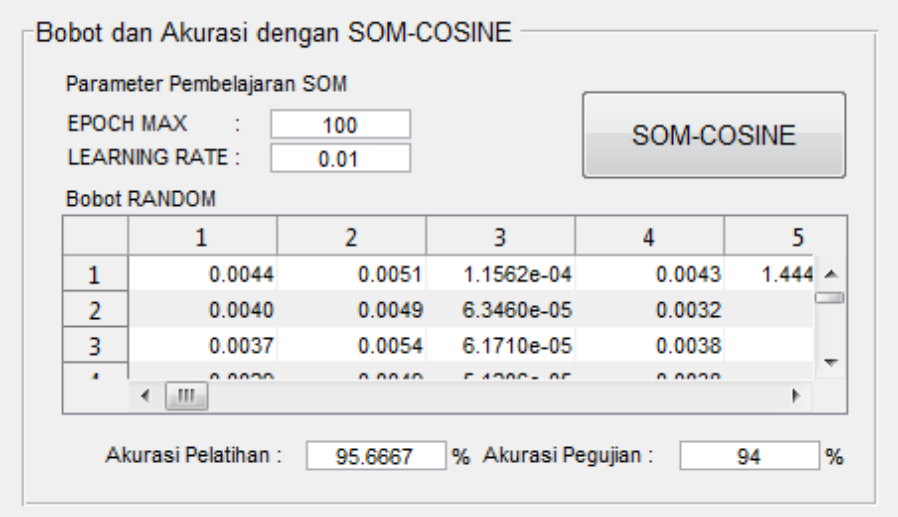

Figure 8
Face Recognition Accuracy with SOM Modified Networks

The final weight generated will be stored in the network during the training process and will be reused for the modified SOM network testing process. The input image in the form of a face image will first be searched for the extraction value of the feature using the LBP (Local Binary Pattern) method as the previous training image. The value used for each test image is the same as the training image, which is the value of the image texture features with a total of 59 character values or features. The results of each individual's testing of the face recognition program can be seen as follows in Figure 9.

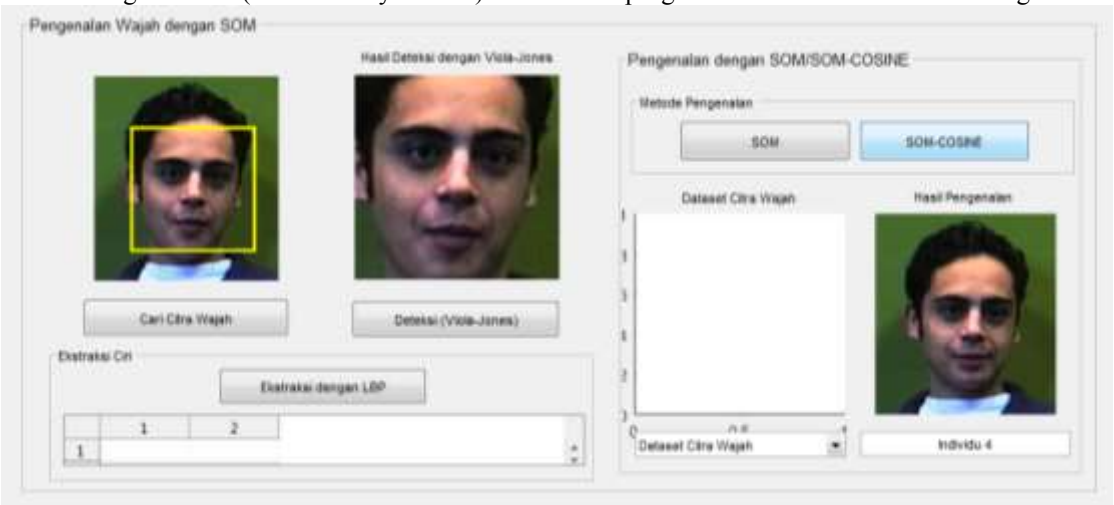

Figure 9
The process of recognition of new images using the modified SOM network

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Recognition results for each data class consisting of 8 test images can be seen as follows in Figure 10.

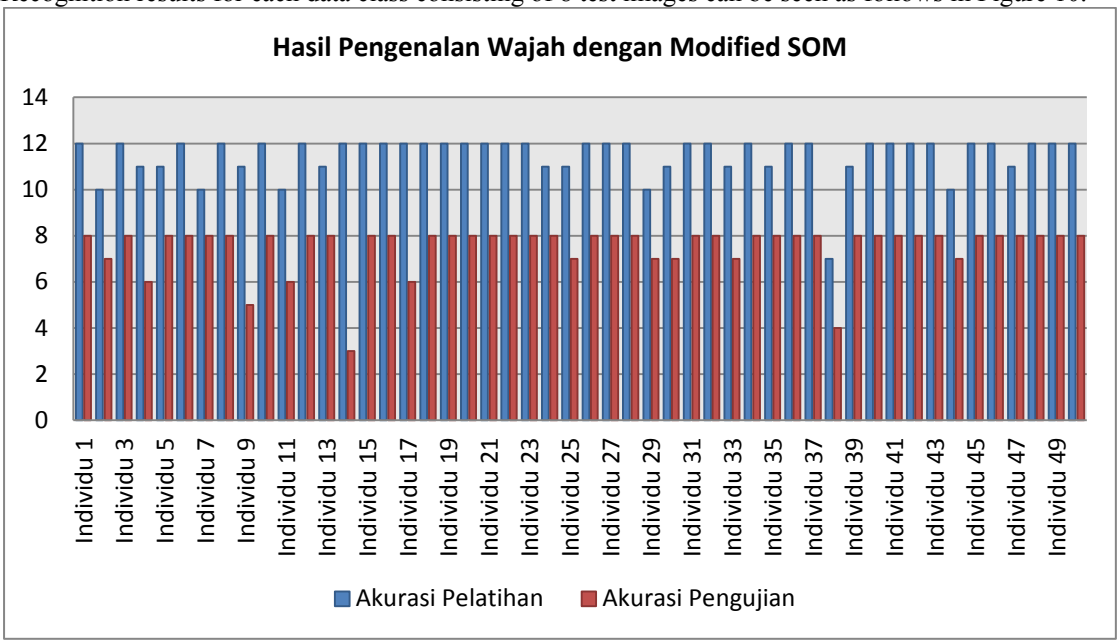

Figure 10
Face Recognition Accuracy in 50 Individuals Using the Modified SOM Network

5. DISCUSSION

The testing process in this study was performed by comparing the same SOM network parameters. The network input (face image), epoch, alpha (α), and dec alpha (α) must be the same so that the process comparison can be well compared. Setting the value is performed by checking with the appropriate parameters.

Table 4
Accuracy of Face Recognition Comparison

Proposed method	True Data		Training Accuracy	Testing Accuracy
	Training image	Testing Image		
SOM	540	351	90.00%	87.75%
***Modified* SOM**	574	376	95.67%	94.00%

From table 4 above, the process of face recognition with the SOM network requires the right initial weight so that the image can be correctly recognized. The results of the comparison of the proposed method can be seen as follows in Figure 11.

Figure 11
Comparison of Accuracy of Face Recognition Methods

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Based on the tests conducted for the face recognition process using the modified artificial neural SOM network, the results were better than the standard SOM. This shows that the method of determining the initial weight used can have an effect on the results of better recognition of the face. In the standard SOM network 3 experiments have been carried out, namely experiments I, II, and III. All three experiments used initial network weights that were randomly determined from training data. Accuracy results obtained from the three experiments showed smaller results compared to the modification of the SOM network by determining the initial weight using cosine similarity.

On the basis of the results obtained between the SOM method and the modified SOM, it can be shown that this network requires the right initial weight to improve the accuracy of facial recognition. The initial weight of the SOM network is normally calculated by a random value with a range of 0-1 values. Initial weight in this study by taking some training data as it can be used as an initial weight in network formation. Training data used as weights are randomly selected according to random selection of training data on the SOM network to obtain different accuracy results, but the accuracy results are not very different. In the meantime, in the modified SOM network, the weights are selected using the cosine similarity method to determine the initial weights. In this equation, the similarity value of the image will be calculated so that the image has the highest similarity to the other images. The image with the highest similarity is the image used as the initial weight in the SOM network and is considered to be the reference image in the network. Similarity searches should be searched for each data group in such a way that each data group has a weight obtained based on the highest similarity.

From the previous description, face recognition using the SOM method obtained 90 per cent accuracy for the network training process and 87.75 per cent accuracy for the network testing process. Whereas for face recognition using modified SOM, the results for facial recognition were 95.67 percent for the network training process and 94 percent for the network testing process. The conclusions reached are therefore an increase in accuracy in the modified SOM network better than the standard SOM with an improvement in training accuracy of 5.67 per cent and 6.25 per cent for network testing. It can therefore be concluded that the process of face recognition using the modified SOM method has a good percentage effect on face recognition.

6. CONCLUSION

Face recognition using the SOM method obtained 90 percent accuracy in the network training process and 87.75 percent accuracy in the network testing process. Whereas for face recognition using modified SOM, the results for face recognition were 95.67 percent for the network training process and 94 percent for the network testing process.

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