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FACIAL EXPRESSIONS RECOGNITION USING BACKPROPAGATION NEURAL NETWORK FOR MUSIC PLAYLIST ELECTIONS

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Abstrak

Penelitian ini dibuat untuk mengenali ekspresi wajah sebagai indikator untuk menjalankan *playlist* musik. Sistem pengenalan ekspresi wajah berasal dari data masukan seseorang yang diambil secara *offline*, dengan posisi terdekat dengan kamera, dimana posisi wajah tidak boleh miring. Prosesnya dengan pengambilan citra wajah secara *offline* yang dikenali dengan kombinasi warna, dan mengekstrak fitur penting dari wajah berdasarkan lokasi alis, mata, dan bentuk mulut kemudian mengenali ekspresi wajah menggunakan Jaringan Saraf Tiruan Propagasi Balik (*Backpropagation Neural Network*). Ekspresi yang akan dikenali Data keluaran dari pengenalan ekspresi wajah berupa indek yang secara otomatis akan digunakan sebagai indikator untuk menjalankan musik, sehingga musik akan berubah mengikuti perubahan ekspresi wajah seseorang. Sistem yang telah dibuat dapat mengenali tiga jenis ekspresi yaitu: normal, marah, dan bahagia. Pengujian dengan pengambilan gambar wajah secara *offline* sebagai data masukan untuk Jaringan Saraf Tiruan Propagasi Balik, dimana pada saat pembelajaran diperoleh hasil yang konvergen dengan *error* terendah dengan jumlah neuron pada lapisan *hidden* sebanyak 10 unit, nilai laju pembelajaran sebesar 0.0625325 dan *nilai mean square error* sebesar 0.0135.

Kata Kunci: Ekspresi Wajah, *Backpropagation*, *Music Playlist*.

Abstract

The objective of the research is to detect facial expression as indicator to cast a music playlist. Facial expression detection system input is performed offline by taking photograph of a subject with nearest position from the camera and facial position should not be tilted. The image is identified as a combination of color and feature extraction is performed based on location of eyebrow, eye, and mouth. Facial expression is detected with Artificial Neural Network Backpropagation method. The output data is an index, which automatically select and play the music. In this way, the music is modified according to the changes of facial expression. The system is designed to detect three facial expressions: normal, angry, and happy expression. The similarity between features values from each expression influence the ability to differentiate each expression. Offline system evaluation is performed with backpropagation neural network method,for learning process, it reaches convergent value with lowest error value when using 10 unit neuron on hidden layer, learning rate value is 0.0625325 and mean square error value is 0.0135.

Keywords: Facial Expression, Backpropagation, Music Playlist.

INTRODUCTION

Recently image processing technology had shown significant improvement. The fact is proved by the increasing number of applications that are developed for our daily life, e.g. facial expression, finger print, signature, etc. Shan et al. [1] invented facial expression recognition based on Local Binary Patterns: a comprenhensive study, Sigit et al developed application of a neural network in recognizing facial expression, riyanto sigit et al [2, 3] developed facial expression using neural network,setiawardhana et al [4] developed a face recognition for guidence robot "IGURO", setiawardhana et al [5] developed facial tracking using PTZ camera with MIMO Adaptive Neuro-Fuzzy Inference System, Calder et al [5] utilized a principal component analysis of facial expressions, Bashyal et al [7] employed recognition of facial expressions using Gabor wavelets and learning vector quantization, Gizatdinova et al [8] inventedAutomatic edge-based localization of facial features from images with complex facial expressions, Geetha et al [9] invented facial expression recognition–a real time approach. This research purpose is to develop music selection from music playlist based on face expression with online camera using neural network back propagation method. This improvement also shows the possibility to develop an application, which is able to recognize facial expression and display it into music medium as emotion state of the user. On the other hand, by recognizing the facial expression, music can be generated according to the emotion state in a particular time. Consequently, from the music that being played, we can recognize their emotion which can help us to communicate efficiently.

The application that we have developed can recognize three types of facial expression, that are normal, happy, and angry. These are the basic expressions and most common human expression.

Moreover, to detect the facial expression, we choose one branch of Artificial Intellegence, called as Neural Network. Neural Network is a non-linier model, trained to map historical data and data value from time series data. In this way, the extraction of hidden structure and its relationcan be used to decide the forecast data. Neural Network was chosen because the performance can be improved by adding more data. Besides, by using Neural network, we do not need to have more knowledge about the feature of facial expression to build the system. System will generalize the feature itself, from many examples that are given as training data.

Historical data consists of expression data sampling (happy, normal, and angry), are given in image format. The historical data is used as training data, whilst the image that is acquired on particular time is used as testing data

FACIAL FEATURE AND FACE RECOGNITION

According to the paper of "*Automated Facial Expression Recognition System Using Neural Networks*" by Jyh-Yeong Chang [10], that facial expression is detected by referring to the difference between feature point and feature distance. Therefore, the system is built to recognize and obtain the feature point (including to locate the facial feature). To extract the feature points, there are three main facial features that affect the variation of expressions:

a. Mouth feature
b. Face feature
c. Eyebrow feature.

According to the detection of the three features above, there are six feature points that is influenced from facial expression:

a. Distance between eyebrow and eyes
b. Eyes distance
c. Mouth distance
d. Distance between two eyebrows
e. Distance from eyebrow and mouth.

Generally, feature points can be obtained from the Figure 1.

Facial Detection System

HaarClassified function is used to perform facial detection. Therefore, it requires data training from xml file. The xml file is a library file of openCV. Detection result is a coordinate information that will be used for further processing, that are cropping and saving the acquired image into another file name. The diagram of facial detection is shown in Figure 2.

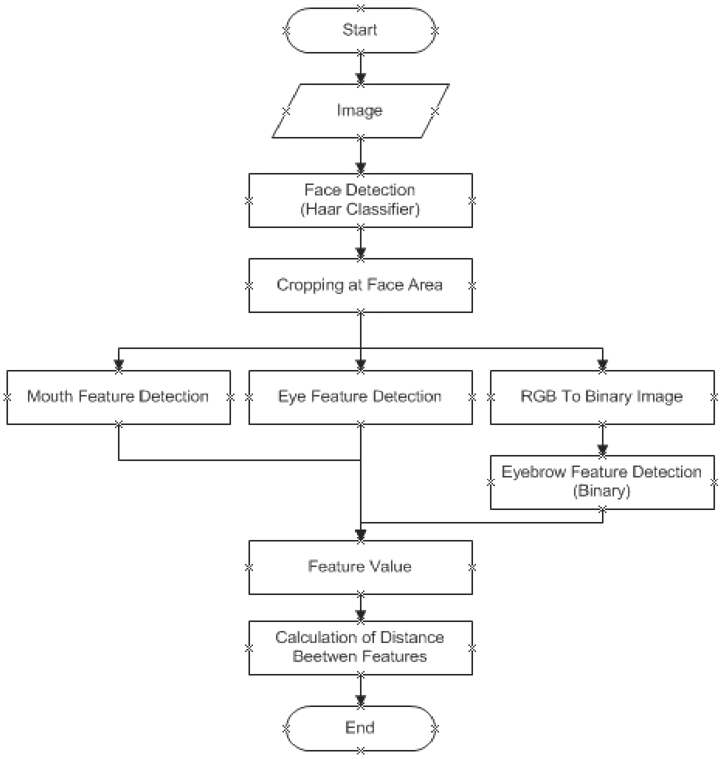


Figure 1. Value Acquisition Process Diagram.

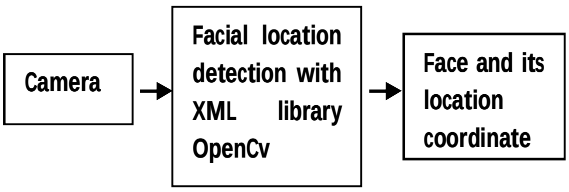


Figure 2. Facial Detection Diagram.

(a) Before Face Detection (b) After Face Detection

Figure 3. Face Location Detection.

Figure 4. Face Acquisition Result.

When face location is obtained, then cropping is performed to localize feature searching only on prescribed area. The result of face detection is shown in Figure 3 and Figure 4.

Facial Feature Detection System

After facial location is identified, feature points are searched with haarClassified function. We utilize this function to detect mouth and eye feature, whilst for eyebrow, we use binary image file. From rectangular position of the feature, we can obtain coordinate value from edge point. We can also calculate the feature value based on the coordinate point. Coordinate position is beginning from upper left corner (the detail is on Figure 5).

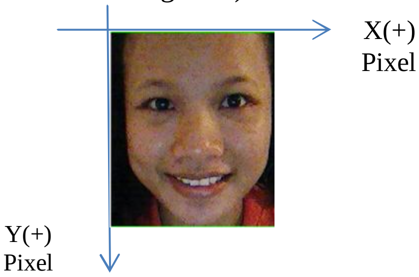


Figure 5. Coordinate System.

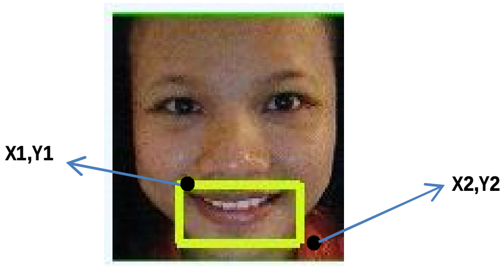


Figure 6. Mouth Feature.

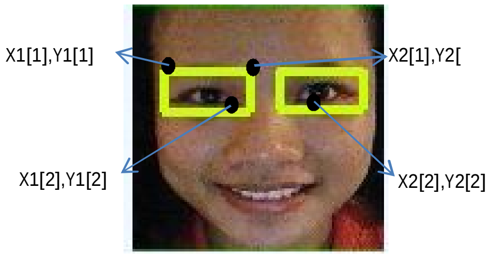


Figure 7.Eye Feature.

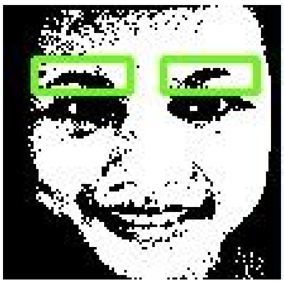


Figure 8. Eyebrow Feature

Coordinate value from each feature can be obtained as follows at Figure 6.

The mouth height value in feature 3 can be calculated by the difference between coordinate on Y axis.

$$F3 = Y2 - Y1 \quad (1)$$

The center point of the mouth is needed to calculate other feature values, therefore:

$$centerX = ((X2 - X1)/2 + X1) \quad (2)$$
$$centerY = ((Y2 - Y1)/2 + Y1) \quad (3)$$

and:

$$center\ mouth = centerX, centerY \quad (4)$$

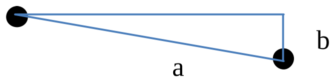
From the Figure 7, two rectangles show the position of right and left eye. Thus, the coordinate value is expressed as an array (*eyeX1*[],*eyeY1*[],*eyeX2*[],*eyeY2*[]).

$$f2 = \frac{(eyeY1[2]-eyeY1[1]) + (eyeY2[2]-eyeY2[1])}{2} \quad (5)$$

The center point between eye1 and eye2 is calculated as the distance of two eyes (feature 5 value).

$$centerEyeX1 = ((eyeX1[2] - eyeX1[1])/2 + eyeX1[1])$$
$$centerEyeY1 = ((eyeY1[2] - eyeY1[1])/2 + eyeY1[1])$$
$$centerEyeX2 = ((eyeX2[2] - eyeX2[1])/2 + eyeX2[1])$$
$$centerEyeY2 = ((eyeY2[2] - eyeY2[1])/2 + eyeY2[1]) \quad (6)$$

As the position of center point is not in parallel of each other, the distance between two eyes, is calculated by phytagoras equation.



$$f5 = \sqrt{a^2 + b^2}$$

$$a = |centerEyeX2 - centerEyeX1|$$
$$b = |centerEyeY2 - centerEyeY1| \quad (7)$$

The distance between eyebrow and eye is acquired by finding the center point between the eyes.

$$centereyeX = ((centereyeX2 - centereyeX1)/2) + centereyeX2$$
$$centereyeY = ((centereyeY2 - centereyeY1)/2) + centereyeY2 \quad (8)$$

Eyebrow feature acquisition is performed based on the eye position feature, therefore eyebrow feature value depend on eye feature. However, eyebrow feature value acquisition requires image thresholding process and image transformation into binary image (black and white) as shown in Figure 8. According to pixel coordinate location of the eyebrow, the lowest ordinate *x* and the highest ordinate *x*(which shown the eyebrow edge),*eyebrowX1*[],*eyebrowY1*[],*eyebrowX2*[], *eyebrowY2*[].

First feature value is decided by obtaining *centereyebrowX* and *centereyebrowY* first.

$$Centereyebrowx1 = ((eyebrowX1[2] - eyebrowX1[1])/2) + eyebrowX1[1]$$
$$Centereyebrowy1 = ((eyebrowY1[2] - eyebrowY1[1])/2) + eyebrowY1[1]$$
$$Centereyebrowx2 = ((eyebrowX2[2] - eyebrowX2[1])/2) + eyebrowX2[1]$$
$$Centereyebrowy2 = ((eyebrowY2[2] - eyebrowY2[1])/2) + eyebrowY2[1]$$
$$CentereyebrowX = ((centereyebrowx2 - centereyebrowx1)/2) + eyebrowx1$$
$$CentereyebrowY = ((centereyebrowy2 - centereyebrowy1)/2) + centereyebrowy1 \quad (9)$$

To calculate feature 1 value (*f1*), that is eyebrow width with eye, the following equation is used:

$$f1 = \sqrt{(centereyebrowx - centereyeX)^2 + (centereyebrowy - centereyey)^2} \quad (10)$$

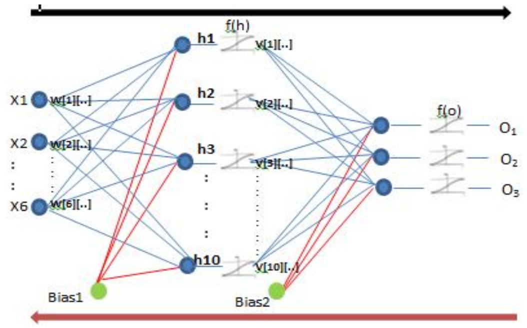


Figure 9. Backpropagation Neural Network Architecture.

To calculate Feature (4) value (*f4*) , that is distance between two eyebrows , the following equation is used:

$$f4 = \sqrt{\begin{aligned}&(centereyebrowx2 - centereyebrowx1)^2\\ &+(centereyebrowy2 - centereyebrowy1)^2\end{aligned}} \quad (11)$$

To calculate feature 6 value (*f6*) that is the distance between eyebrow with mouth, the following equation is used:

$$f6 = \sqrt{\begin{aligned}&(centermouthX - centereyebrowX)^2\\ &+(centermouthY - centereyebrowY)^2\end{aligned}} \quad (12)$$

BACKPROPAGATIONNEURALNET WORK

Backpropagation Neural Network Design for Facial Expression Detection

Neural network is used to detect facial expression from the calculation of feature values. With backpropagation techniques, neuron hidden layer is designed as 9 units and output layer is designed as 3 units. For the output layer, output data is digitized as binary 0 and 1. The architecture detail is displayed in Figure 9.

According to system architecture in the upper figure, six layer input are referred: eyecenter (*F1*), eyewidth (*F2*), mouthwidth (*F3*), distance between two eyebrow(*F4*), distance between eye(*F5*) and distance between center of the two eyebrows and center of the mouth (*F6*).

The example of the six features value can be written as follows:

F1=10 *F4*= 68
F2= 19 *F5*= 59
F3= 25 *F6*= 72.0277724214764

Whilst for output layer, three units is obtained as combination of three facial expression.

*O*1=0, *O*2=0, *O*3=1 for normal expression.
*O*1=0, *O*2=1, *O*3=0 for happy expression
*O*1=1, *O*2=0, *O*3=0 forangry expression

Backpropagation Neural Network Calculation

According to Figure 9 that backpropagation neural network training consists of two main processes, forward and backward.The detail of the processes can be explained further as follows:

Step 0: Initially assign the first weight values, includingweight of input layer to hidden layer,weight of hidden layer to output layer and weight of each bias (random value).

Step 1: If the output of the process is false, then do Step 2 to 9.

Step 2: Perform training on neural network by executing Step 3 to 8.

Forward Process

Step 3: Each unit on input (*Xi*, *i*=0….5) receive input value from detected feature and sent the signal to every unit on upper layer (hidden layer).

Step 4: Each unit (*hj*, *j*=0….*n*) from hidden layer is calculated asthe result of summation of input signal multiplied withits weight.
Activation to each hidden unit value as hidden output value.

$$h_i = f(h_i) \quad (13)$$

After that, the signal (*hi*, *i*=0…..*n*) is sent to upper layer again (output layer) to obtain output value from system. The objective is to achieve expression value set.

Step 5: Each unit output is calculated by summing the product of the weighted value of the hidden layer with output layer.

$$O_i = (\sum_{j=0,k=0}^{i=output,k=neuron} h_k * v_{ki}) + wb2_i \quad (14)$$

Activation of output signal

$$o_i = f(o_i) \quad (15)$$

Table1. Facial Expression Images.

Name	NormalExpression	Happy Expression	Angry Expression
Ratih			
Mutia			
Andrea			
Redy			
Arifin			

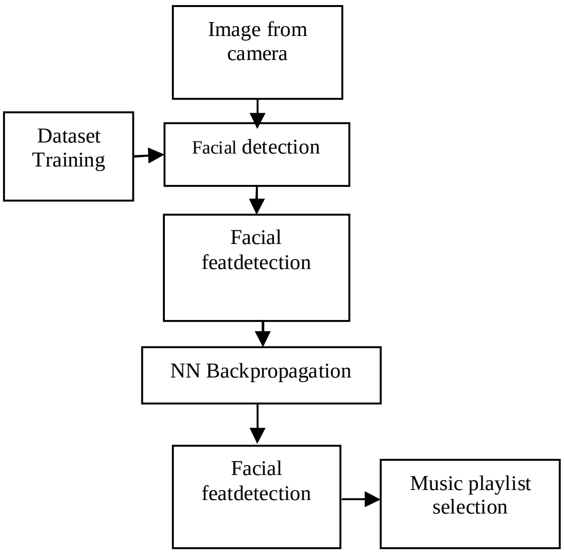


Figure 10. System Diagram.

Error Value Calculation

Step 6: On each output unit (*Oi* , *i*=0……*n*) receives pattern that is similar to forward training and then calculate the detected error value in output layer.

$$e_i = (t_i - O_i) \quad (16)$$

Weight limit value is calculated to update *Vji* value.

$$\Delta V_{ij} = \alpha * e_i * h_j \quad (17)$$

Bias limit value on output layer is calculated to update b_{2i}.

$$\Delta b_{2i} = \alpha * e_i \, , \quad (18)$$

whereas:

i=0….number of output
j=0….number of hidden neuron
e_i values are sent to lower layer to obtain weight limit value from lower layer.

Step 7: On each hidden unit (h_i ,*i*=0 ….. *n*), input delta is summed and multiply with hidden layer value to calculate error limit value of hidden layer.

$$eh_i = h_i * (1 - h_i) * (\sum_{j=0}^{j=jmlOutput} e_j * V_{ij}) \quad (19)$$

Weight limit value is calculated to update W_{ji}value.

$$\Delta W_{ki} = \alpha * eh_i * X_k \quad (20)$$

Bias limit value on hidden layer is calculated to update b_{1i} value

$$\Delta b_{li} = \alpha * eh_i \quad (21)$$

whereas:

i=0…. Numberof neuron hidden
j=0…. Number ofoutput
k=0…Number of input

UpdatingWeightand Bias

Step 8: Each unit input (*Xi* , *i*=0 …. *n*) will update bias and weight to hidden layer.

$$W_{ij}(new) = W_{ij}(old) + \Delta W_{ij} \quad (22)$$

$$b_{1j}(new) = b_{1j}(old) + \Delta b_{1i} \quad (23)$$

Then, each hidden unit will update bias and weight to output layer.

$$W_{jk}(new) = W_{jk}(old) + \Delta W_{jk} \quad (24)$$

$$b_{2k}(new) = b_{2k}(old) + \Delta b_{2k} \quad (25)$$

Step 9: Check for looping termination.

Playlist Selection with Combination of Expression Detection Index

From the calculated feature values, then processed with backpropagation neural network method using forward function, feature value output is acquired. Then, it is classified as angry, normal or happy expressions. The expression index is saved into variable of expression index as follows:

001: normal facial expression
010:happy facial expression
100:angry facial expression

After index is detected, system will automatically load the song playlist that is synchronized with each index of facial expression.

Facial Expression Detection Diagram

The system is operated as follows at Figure 10, the diagram above utilizes image captured from camera at the present time. The captured image will be entered into facial detection process. Later on, features value detection process will be performed with backpropagation neural network method.

After facial expression is detected and expression index is obtained, the system will automatically play the music.

RESULT AND DISCUSSION

On evaluation, image capture is performed from loading thesaved image and from online camera detection. When program is running, automatically system will train the data with backpropagation neural network method. Therefore, the system merely requireswaiting for the new image. Training data is obtained from facial expression image from several people.

From Table 1, we can acquire the data of facial image to calculate feature values. Differentiation of feature values is required from different expression, e.g:

1. Angry: distance between eyebrow and eye position is smaller, eye widened, distance between eyebrow distance is smaller.
2. Happy: Mouth height is widened.

Based on Table 2, we can observe three different expression with their corresponding feature values. Each feature values appear to be different, but the most significant effect is the value that is examined from eyebrow and eye feature. Whilst data with grey block shows incompatible feature values.

Table 2. Feature Value Based on Different Expression.

Features	Eyebrow Height	Eye Height	Mouth Height	Eyebrow Distance	Eye Distance	Distance between Eyebrow and Mouth
				Angry		
Ratih	28	21	27	12	62	75.591
Mutia	23	43	27	53	61	61.400
Andre	21	37	24	45	38	63.198
Redy	19	18	26	32	10	56.080
Arifin	37	46	25	49	17	81.633
Happy						
Ratih	14	18	27	67	41	65.253
Mutia	26	56	26	51	47	67.742
Andre	13	16	27	53	43	67.364
Redy	22	43	26	49	20	65.253
Arifin	0	14	27	0	14	0
				Normal		
Ratih	13	19	24	62	54	65.115
Mutia	36	44	32	83	37	36.124
Andre	27	43	27	49	31	68.883
Redy	20	38	25	38	27	57.078
Arifin	25	37	5	3	36	45.793

Table 3. Offline Facial Expression Detection Result.

Name	Angry Expression	Normal Expression	Happy Expression
Nawang	√	√	√*
Peni	√	√	√
Sany	X	X	√
Raga	√	√	√
Redy	√	X	√
Mutia	√	√*	√
Andre	√	X	X
Ratih	X	√	X
Arifin	X**	X	√
Mukhlis	X	X	√

Table 4. Online Facial Expression Detection Result.

Name	Angry Expression	Normal Expression	Happy Expression
Adi	X	√	√
Peni	X	√	√
Melisa	X	√	X
Sari	X	√	√
Dita	X	√	X
Percentage (%)	0%	100%	60%

Table 5. Variation of Neuron Number with *K_zero*=200.

No	Number of Neuron	Number of Iteration	MSE	Learning Rate
1.	1	50000	0.2205	0.00298216
2.	2	50000	0.2208	0.00298216
3.	3	50000	0.2211	0.00298216
4.	4	50000	0.1192	0.00298216
5.	5	50000	0.2216	0.00298216
6.	6	50000	0.1011	0.00298216
7.	7	50000	0.1013	0.00298216
8.	8	50000	0.0852	0.00298216
9.	9	50000	0.2166	0.00298216
10.	10	50000	0.1028	0.00298216

From the training data in the form of feature values, the system can be operated based on previous calculation that had been processed with backpropagation neural network method. The training process is aimed to obtain the best weight function for expression detection.

(*) Facial expression detection is compatible but location extraction is error.
(**) error on feature extraction / incompatible with problem.

Based on Table 3, general calculation based on the number of success and failure detection,can be expressed as follows ,whereas 6 people with 3 expression is employed for the experiment.

Σ_experiment =3 x 10 = 30
Σ_success = 19
Σ_failure = 11

The percentage of failure and success for all type of expression can be expressed as follows:

%success $=\left(\frac{19}{30}\right) x\ 100\%$ =63,33%
%failure $=\left(\frac{11}{30}\right) x\ 100\%$ = 36,67%

The percentage of success and failure for each expression type can be expressed as follows :

- Angry Expression:
  %success = $\left(\frac{6}{10}\right) x\ 100\%$ = 60%
  %failure = $\left(\frac{4}{10}\right) x\ 100\%$ = 40%
- Normal Expression:
  %success = $\left(\frac{5}{10}\right) x\ 100\%$ = 50%
  %failure = $\left(\frac{5}{10}\right) x\ 100\%$ =50%
- Happy Expression:
  %success = $\left(\frac{8}{10}\right) x\ 100\%$ = 80%
  %failure = $\left(\frac{2}{10}\right) x\ 100\%$ = 20%

The experiment is performed by observing the alteration neuron value, *miu_zero* , *k_zero*, and error tolerance to understand its effect with mean square error (MSE) and iteration number.

General percentage calculation based on the total number of experiment can be described as follows:

Σ number of experiments = 15
Σ success = 8
Σ failure = 7
Success percentage = 8/15*100% = 53,33%
Failure percentage = 7/15*100% = 46,66 %

Based on Table data 4 and result calculation for online facial expression detection is 53.33% is done successfully, with affinity for normal expression.

Table 6. Optimation Learning Rate, MSE, and Iteration.

No.	Error Tolerance	Iteration	MSE	Learning rate
1.	0.011	50000	0.0933	0.00239
2.	0.012	50000	0.0933	0.00239
3.	0.013	50000	0.0933	0.00239
4.	0.014	1719	0.0135	0.06253
5.	0.015	1718	0.0140	0.06256
6.	0.016	1717	0.0154	0.06259
7.	0.017	1716	0.0168	0.06263
8.	0.018	1715	0.0178	0.06266
9.	0.019	1700	0.0189	0.06315
10.	0.02	1691	0.0199	0.06345
11.	0.021	1683	0.0209	0.06372
12.	0.022	1676	0.0219	0.06396
13.	0.023	1669	0.0229	0.06420
14.	0.024	1661	0.0239	0.06448
15.	0.025	1652	0.0249	0.06479
16.	0.026	1641	0.0259	0.06518
17.	0.027	1629	0.0269	0.06560
18.	0.028	1620	0.0279	0.06593
19.	0.029	1614	0.0289	0.06615

Based on the unit number of hidden layer, number of node affect MSE value and number of iteration to obtain valid expression detection. Whereas on specified number of node, to obtain lowest iteration number and lowest error with best weigh value; experiment is performed with the following value: *k_zero* = 200, *miu_zero* = 0.5, *error tolerance* = 0.05 , and *maximum iteration* = 50000. The number of neuron that will be used are taken from neuron with two lowest MSE.

From Table 5, the two of the lowest MSE resultsare obtained from number of neuron 8 and 10 units. Therefore neuron with 8 and 10 units will be used to evaluate other variable for optimality.

To operate the playlist, each song requires the probability data for each facial expression. Below, we listed fifteen songs with its probability value.

From Table 6, Offline system evaluation is performed with backpropagation neural network method.For learning process, it reaches convergent value with lowest error value when using 10 unit neuron. Learning rate value is 0.0625325, with momentum value 0.6, *k_zero* 200 and error 1.3%.

Table 7 shows the probability value for each song. Output value from facial expression detection is calculated with the probability on Table 6 to obtain probability distance. The nearest probability distance is ranked, together with expression output value and expression index; are calculated. Playlist is operated based on facial expression detection and the percentage value obtained on the ongoing detection. The interface of the playlist is shown in Figure 11.

Facial expression detection process starts with pushing the CamOn button for online detection from camera as shown in Figure 12. Take(Offline) button is used for offline camera. For offline detection, the image capture is performed at the moment. CekDtc button will load the saved image, therefore, the image that is employed, is not the recent capturedimage as shown in Figure 13.

Table 7. Probability Value for Each Song with Three Expressions.

Song Title	Probability		
	Normal	Happy	Angry
Eminem:Love The Way You Lie	0.26	0.29	0.45
Christian B:The Way You Look At Me	0.28	0.61	0.12
LinkinPark: In The End	0.26	0.23	0.51
Cangcuter :Parampam	0.21	0.66	0.12
Jrock: Ceria	0.20	0.70	0.10
Sheila On 7:Pasti Ku Bisa	0.36	0.48	0.16
Tompi:SedariDulu	0.34	0.51	0.15
Citra: Every Body Knew	0.32	0.43	0.25
Kotak:Pelan – PelanSaja	0.35	0.33	0.33
EvieT:SelamatMalam	0.27	0.46	0.27
DewiS:Lembayung Bali	0.73	0.09	0.18
Muse:UndisclosedDesires	0.78	0.08	0.13
Rocket Rocker:Edane	0.15	0.08	0.80
Bring Me The Horison: Play for Plague	0.11	0.09	0.80
Trivium: To The Rats	0.13	0.08	0.79

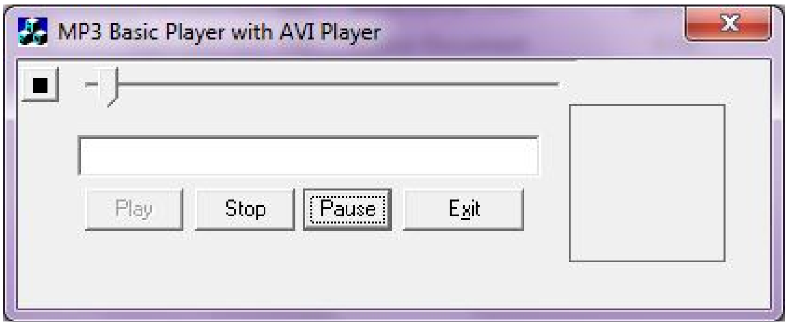


Figure 11. MusicPlayerUserInterface.

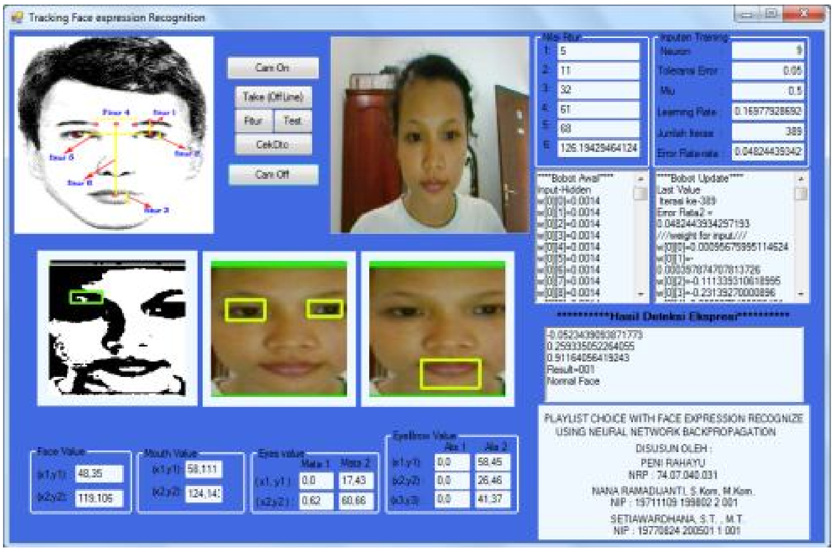


Figure 12. Online FacialExpressionDetection.

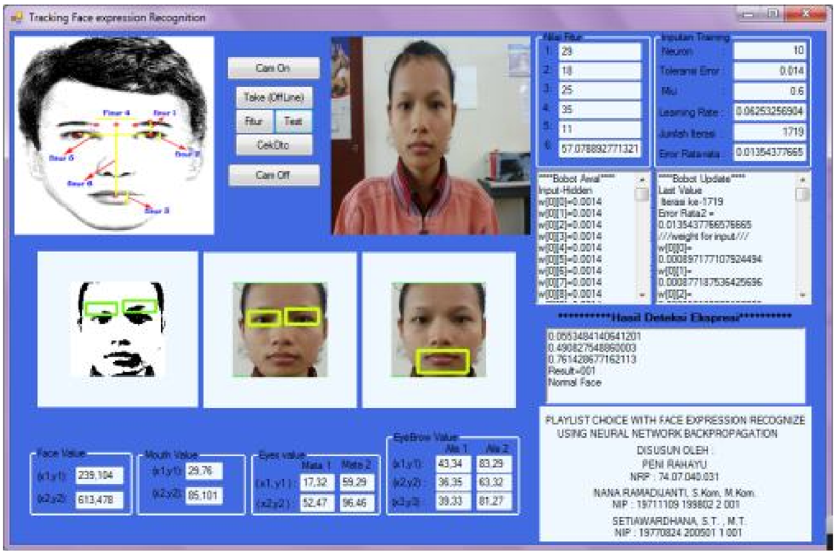


Figure 13. Offline FacialExpressionDetection.

CONCLUSION

Conclusions for the research are explained as the system is designed to detect three facial expressions: normal, angry, and happy expression. The similarity between features values from each expression influence the ability to differentiate each expression. Offline system evaluation is performed with backpropagation neural network method.For learning process, it reaches convergent value with lowest error value when using 10 unit neuron. Learning rate value is 0.0625325, with momentum value 0.6, k_zero 200 and error 1.3%, from Table 6. So offline expression detection shows better accuracy than online expression detection, by 63,33% (offline) compare with 53,33% (online), from Table 3 and Table 4.

Improvement for this research can be achieved by increasing the quality of the image to reduce noise. The noise mostly caused by lighting. Poor lighting will requires system to do resetting on the image before detection process. By managing the lighting noise,we can improve the image quality and enable the system to perform detection on either day or night.

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