

Face Recognition with Backpropagation Artificial Neural Networks Using the Sigmoid Activation Function

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Abstract— In the current development of information technology facilities that are so rapid and complex, the reliability of a system that processes data properly will produce good information. The use of computers today is not only to help human work, but has also replaced human work in various fields. The purpose of this research is to design an image model in an application program. This existing digital image can then be used for various purposes. One way is to take photos on a driver's license (SIM), when taking photos directly using a digital camera and facial photo files are also directly stored in the police database. So this facial photo recognition program can actually also be applied by the police to recognize the faces of criminals. From the 10 experimental samples, it can be concluded that the best Learn Rates with the lowest Error Level for BMP format files are for learn rate 0.2 with an error rate of 18,54229 and a match rate of 81,45771 with a recognition rate of more than 60% in photo 2, while with an error rate of 51.00543 and a match level 48,99457.

Keywords : Reliability, Recognition, Backpropagation, Artificial Neural Networks

I. INTRODUCTION

The era of information technology is growing rapidly and complex, the reliability of a system that processes data properly will produce good information. The use of computers today is not only to help human work, but has also replaced human work in various fields. Further developments, experts try to replace the working nature of the human brain, so it is hoped that one day a computer will be created that is able to think like humans.

One of the branches of artificial intelligence that is well known is an artificial neural network (Artificial Neural Network System), an artificial neural network is an information processing system whose working characteristics resemble human biological neural networks. The development of int is supported by advances in the field of computers both from software (software) and hardware (hardware).

Human efforts to develop a system that imitates the abilities and behavior of living things have been going on for the past few years int. Artificial neural networks are the result of the development of science and technology which is currently developing rapidly. An artificial neural network in the form of an arrangement of artificial nerve cells (neurons) is built based on the working principle of the human brain. Great attention to artificial neural networks is due to the advantages it has, such as the ability to learn and fault tolerance.

Now int the latest technology that exists has entered the digital era." I-almost all equipment that can help humans today is made in digital form, from technology

for large-scale industries to household appliances that can be used daily. Likewise in the field of photography. at this time there have been many digital cameras and digital camcorders. With digital cameras or digital camcorders, the resulting images can be directly viewed through a computer. This existing digital image can then be used for various purposes. One way is the photo on the SIM when taking photos directly using a digital camera and the facial photo files are also directly stored in the police database, so this facial photo recognition program can actually also be implemented by the police to recognize the faces of criminals.

II. LITERATURE REVIEW

Intelligent systems are a part of the study in artificial intelligence (Artificial intelligence or AI), in addition to natural language processing, robotics and others, which make an integrated computer system capable of solving a problem faced like human thinking and able to provide solutions that good. Intelligence or intelligence means someone who is good at implementing the knowledge he has. With this understanding, it can be concluded that even though a person has a lot of knowledge, if he cannot carry it out in practice, he cannot be classified as intelligence. The main part of the application of Artificial Intelligence is knowledge, a knowledge of several subject areas that is obtained through education and experience. Although the computer may not get experience or learn and research like humans, but it can acquire the knowledge needed, through the efforts of an expert.

Knowledge consists of facts, thoughts, theories, procedures and relationships with each other. Knowledge is also organized and analyzed information so that it can be more easily understood and can be applied to problem solving and decision making. Almost all knowledge bases are very limited, in the sense that they are mostly focused on a specific problem. When the knowledge base has been formed, the Artificial intelligence technique can be used to give new capabilities to the computer so that it can think and make inferences (make decisions based on decisions) and make judgments based on the facts and relationships contained in the noise base. . The process starts from input in the form of problems, data and questions, then in a computer that has been equipped with a knowledge base that is in accordance with the problem to be solved, it provides an output in the form of a solution or answer, of course, after the inference and tracking capabilities with the knowledge base are run.

An image is a collection of image elements (picture element pixels) which as a whole record a scene (scene) through visual sensing. Each pixel located at a certain coordinate position on the layer has a certain color value. Figure 2.2. In general, the activities carried out in image processing are processing two-dimensional digital images using computer. Image is a spatial dimension that contains color information and does not depend on time. Color is a collection of dots from an image, called a pixel image element). These points represent coordinate positions and have intensities that can be expressed in numbers. This intensity shows the color of the image, through the addition of r (Red, Green and Blue RGB). Coordinates provide pixel color information based on; Brightness (sharpness) the color of light (black, gray, white) from the source, the (hue) caused by the color (red, yellow, green etc.) and is the dominant wavelength of the source. For example, an image with 8 bits per pixel has 256 colors and an image with 24 bits has 16,777,216 colors, so each pixel is represented by bits 0 to 7 for red, bits 8 to 15 for green, bits 16 to 23 for blue. Possible color combinations are $2^8 + 2^8 + 2^8 = 256 + 256 + 256 = 16843.008$, where the value 0 represents black color while the value 16,777,216 represents white color. From the brief explanation above, the image can be changed from a spatial domain to another domain, with the aim of simplifying coding. The process of changing into is called transformation.

Artificial neural network technology is an imitation of the nervous system of animals. This technology turned out to provide a change in the epistemological programming system that we know traditionally. Artificial neural nets process information in a very different way than conventional ones. Computing occurs in data processing units, which are numerous, parallel and distributed. A way that is very different

from the classical architecture that processes data serially. In artificial neural nets, information is distributed in artificial neural nets, instead of being allocated in a certain place, whether it is a computer memory address or something else. That is why, from the very beginning, this technology has been referred to as parallel distributed processing technology, to distinguish it in the old way.

Information processing in an artificial neural network can be abbreviated as follows, signals (either in the form of action or potential) appear as input units (synapses), the effect of each signal is expressed as a multiplication form with a weighted value to indicate the strength of the synapse. All signals given an input weight multiplier are then added together to produce an activation unit. If this activation exceeds a certain threshold, the unit will provide output in the form of a response to input. This functional ability in artificial neuron engineering is known as Threshold Logic Unit (TLU). Artificial Neural Networks = ANN (Artificial Neural Networks) modeling biological neural networks found in the human brain. Modeling is mainly only approached from a computational point of view. ANN consists of a number of nodes (nodes) which are processing elements. Each of these nodes models a biological neuron (neuron). The connection between nodes is achieved through connection weights (weight). The weight of the connection determines whether the signal flowing is an inhibitory connection or an excitatory connection. The weight of a damping connection can be expressed, for, by a negative number, while a stimulating one by a positive number. In addition to being determined by the characteristics of the connection weight, the amount of signal that comes out of a node is also determined by the activation function it uses. That is, the selection of the activation function determines the degree of activity of a node.

III. RESEARCH METHODS

After the design process is carried out, the next step is to implement the design into the program. In the process of implementing this program the user will interact with the software with a GUI (Graphical User Interface) interface. Users can make their choices from the available menus. This software system is made using Borland Delphi 7 Software

3.1 Problem Analysis

An image of a face photo (hereinafter referred to as face recognition). which will be identified using JSB, must go through certain stages first so that it can be a good input for the ISB. The input that can be well received by the ISB is in the form of a collection of binary data. Thus, the first problem is how to convert a

digital image into a representative and consistent set of binary data. Of course, although the JSB used has specific characteristics, structures or configurations, there are still other important parameters of the JSB that must be adjusted to get the best results. Parameter - these parameters include the influence of bias and initial weight, momentum value, LearnRates value, stopping criteria error value, epoch (timeframe), and so on. Adjustment is the next problem to be analyzed.

3.2 Data Acquisition Method

Each sample to be observed and analyzed by the ISB must be properly represented in the form of binary data. For that we need a method that can extract characteristic data from each sample earlier consistent. Of course, the resulting binary data must really be able to represent the characteristics or characteristics of the observed sample, so that It is expected that from a set of data with the same target, a generalization or general characterization of a similar target will be generated. Process the data acquisition must be completely accurate by considering all the characteristics and each sample is nothing but a digital image, where each digital image has certain characteristics.

The samples to be observed must of course be limited by a simple dimensional structure and pixel homogenization, so that it is hoped that this will facilitate the analysis process of this concept. Each sample is a digital image of the color value of the pixels the pixels are homogenized into three color representations, namely the colors Red (Red), Green (Green), nn Blue (Blue) and then converted to degrees of gray (Gray Scale). In addition, the dimensions of each sample are limited to the area provided in the application program, but this will not reduce the expected flexibility and scalability.

3.3 Data Extraction

To obtain accurate and consistent data from each face photo image, a simple method is used, namely by counting the number of active pixels contained in parts of the sample.

The general algorithm for extracting binary data from each sample is as follows:

1. Each observed sample is divided into several areas, such as columns and 3 rows, so that there will be 9 observation areas;
2. The number of active pixels from each existing area is calculated accurately;

After going through the normalization stage, the binary data will become input data to the JSB. Thus the number of areas in each sample will correspond to the number of JSB input neurons that will be used. In order to produce a uniform data set, each sample to be observed must have the same number of areas.

IV. RESULT AND ANALYSIS

The first experiments carried out were influence analysis values LearnRateS Momentum values, and the last is the effect of the initial value range. For the first two experiments, the initial value range of -2 to 2.

The experiment to be carried out will be given several limitations so that effective results can be obtained. These limitations include:

1. The samples that will be used in the discussion and analysis are Image 1 with fieg/on — 3 * 3;
2. The maximum number of epochs (period) is 100, where this epoch is a fixed variable that was carried out as an experiment;
3. The learning process is stopped when one of the two imiteria has been reached, namely HardTrapping MatchLevel or Stopping Criteria False.
4. For each case, several experiments were carried out and the best one was chosen to be displayed in the discussion, and to be used as a temporary reference for the next learning process;
5. The best results and experiments are determined and the HardTrapping MatchLevel value is greatest and or the Stop value is when the criteria is the smallest
6. The experiment is declared successful if the MatchLevel condition is reached — 100%, or greater, which means that the JSB 'is able to recognize itself;
7. The main objective of this experiment is to obtain the best characteristics of the JSB so that the JSB can study the given pattern well.

4.1 System Menu

In this face identification system, the composer uses the PullDown menu. The use of this menu is intended to facilitate the operation of Information, with the Pulldown menu, the operator or user stays choose from the available alternatives. The alternatives that exist include the following:

1. Main Menu or Face Recognition

In this menu there are several sub menus, where the main menu is a menu where we can process all the results of face identification.

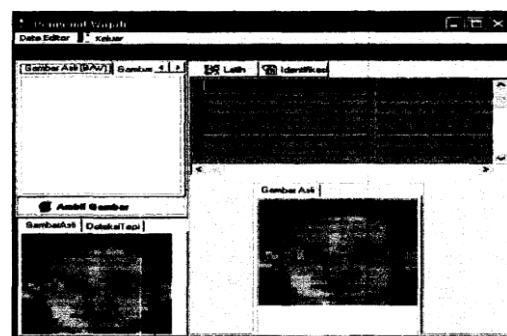


Figure 1. Main Menu Face Identification

In the main menu, there are other menus, these menus including the following:

a. Menu Data Editor

This Data Editor menu has a Personal Editor sub menu, a sub menu Editor's Questions consist of: Personal data This Personal Data has a function to add data and delete data.

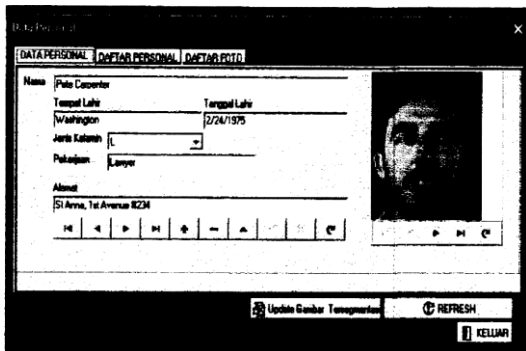


Figure 2. Personal Data Menu

b. Personal Register

The Personal list holds all the identities of the people who have been entered. In this personal list form, we can also search for someone's name that has been entered, either alphabetically or in a whole search.

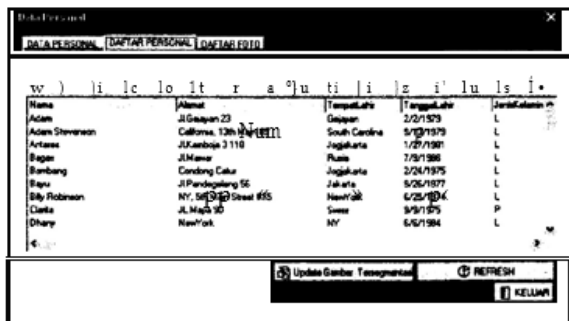


Figure 3. Personal List Menu

c. Photo List

The int form contains the following buttons:
P Add Image Button

This button is used to add images to the database, klik Delete Image Button, This button is used to delete existing images in the database. Segmentation Update Button. This button is used to segment images into patterns. Klik button

This button is used to restore the running of the program smoothly. Exit Button This button is used to exit the personal data form to the main menu.

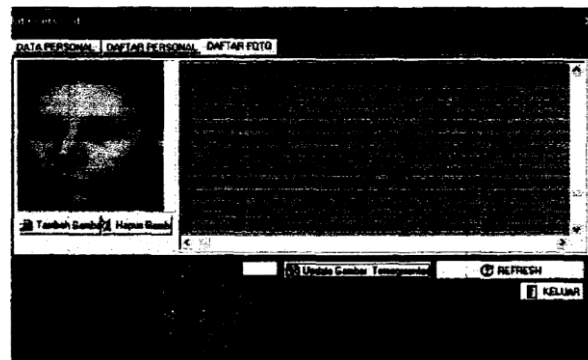


Figure 4. Photo List Menu

2. Experiment Method

In this experiment, previously some images have been stored in the database, then input the same photo but with different facial expressions, the photo can be in color or black and white. The learning level is tried starting from 0.1, 0.2, 0.3, to 1. But the image has not been normalized because if it is normalized there will be changes in the results.

3. Image Normalization

Of course, the sample made is unlikely to have the same dimensions identical to one another. This int is a scalability factor. In addition, each sample will also have a unique shape, it can be said that it is impossible for two samples to be identical in shape. This is a flexibility factor. However, to maintain the scalability and flexibility factors, the binary data generated in the previous process will be lag inconsistent. For this reason, an additional process is needed to maintain data consistency against the observation sample, namely that each binary data must go through a data normalization process. The normalization method that will be used is also the simplest normalization method, namely the normalization of fixed ratios. In the case of int, the ratio between the number of active pixels in each area in a sample will be compared (divided) by the largest number of active pixels in one area in the same sample. The result of the int normalization process is a set of binary data that has a value between 0 (zero) and 1 (one).

The process of face detection and face normalization can be carried out successfully depending on how well the two bekeqa modules are alike. Face detection will be successful if the face input is nominalized so that its orientation and exposure are similar to those stored in the system templates. In other words, the input image must be adjusted so that it will appear as if all the input images can be captured under the same environment and conditions. Int is the biggest challenge yet to be solved by many experiments classified in the int area,

and the main reason why a complete solution to the problem in facial recognition & lum was introduced. Face normalization can be divided into three main categories namely scaling normalization, rotation normalization and exposure normalization. In the table below, int that the image is calculated using binary data and each pixel, the pixel value is taken from the number of matrix multiplications of 3 * 3. With the nomination process, it is clear that the photo image will change its value.

The sample is taken as a sample Image of my own photo and then the photo is implemented into an Image matrix. The active regions are taken:

Table 1. Active Pixel Region Matrix

8883405	9410001	10001361
9014477	9409487	10066382
8947914	9277130	10065611

Table 2. Active Pixel Region Matrix converted to Binaries

10001000100000	10010100000100	10000000000000
11010000000101	00000000000001	0010011011 00001
10010000000101	10010100000010	100000000000001
00010001110111	01010010000111	10011000111000
10001001010001	10010010011101	100000000011001
11100100010100	11000100110000	01011000010001

The image below is an image that will be normalized, and later the image is normalized and the active pixel value is taken, meaning we take it according to the size of the matrix and find the part that, presumably, can be used as a guideline as a target in the future. The ones marked in red are the areas to be normalized. This normalization process too, I like in the figure 5.



Figure 5. Image Photos to be Normalized •BMP

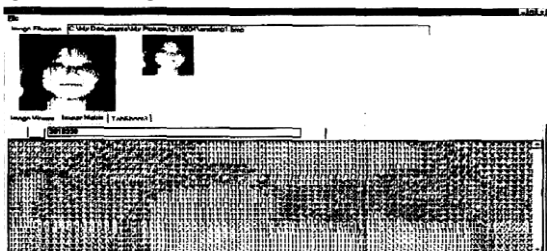


Figure 6. Photo Matrix Region

The image above is an image that has gone through the normalization process, making the image unclear because the active pixel values have already been compared. By normalizing the int it becomes possible when image recognition is difficult to recognize.

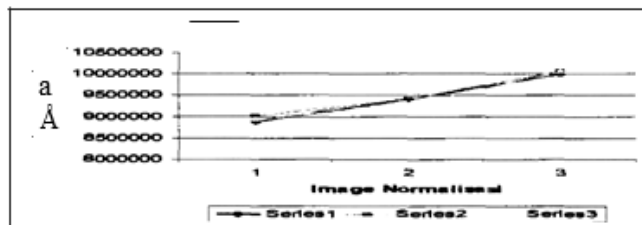


Figure 7. Normalized Graph Based on Image Matrix

Listing program for Face Recognizer unit Application program script :

```

unit UnitFaceReq;
interface uses
Windows, Messages, SysUtils, Variants, Classes, Graphics,
Controls, Forms,
Dialogs, ExtDlgs, GraphieEx, GR32, GR32 Transforms, GR32
Filters, GR32 Image, ComCtrls, Buttons, ExtCtrls,
UnitGraphicProcessor, StdCtrls, DB, ADODB, DBCtrls, Grids,
DBGrids, Gauges, faststrings, faststringfuncs,
Menus;

TFrmPengenalWajah = class(TForm), Panel1: TPanel; Panel2:
TPanel; Panel3: TPanel; Panel4: TPanel; SpeedButton1:
TSpeedButton; PageControl1: TPageControl; TabSheet1:
TTabSheet; Panel5: TPanel; OriginalImage: TImage32;
TabSheet2: TTabSheet; Panel6: TPanel; ImageSegmented:
TImage32;

OpenPictureDialog1: TOpenPictureDialog;
Image321: TImage32;
TBFOTO: TADOTable;
TBFOTOID: TAutoIncField; TBFOTOFotoAsli: TBlobField;
TBFOTOFotoSegmentasi: TBlobField; TBFOTOYangPunya:
TIntegerField; Panel7: TPanel;
PageControl2: TPageControl; TabSheet3: TTabSheet; TabSheet4:
TTabSheet; Image322: TImage32; Image323: TImage32;
    
```

VI. CONCLUSION

The main conclusion that can be drawn is that the facial image recognition method that is made can be implemented properly on a back propagation neural network with prewitt edge detection also using the sigmoid activation function.

From the 10 sample experiments, it can be concluded that the best Learn Rates with the lowest Error Level for the BMP format file are for learnrate 0.2 with an error level of 18.54229 and match level 81.45771 with a recognition rate of more than 60% is found in photo 2, while with an error rate of 51.00543 and match level 48.99457, the photo cannot be recognized in photo 10.

As for the JPG file, the result is not that far from *BMP but judging from the result *JPG not good as facial recognition input.

From the results of the second comparison for Image, it turns out that the photo format is BMP is better at face identification, although *JPG format can be done, but the JPG format when normalizing the image results is much different from *BMP. Thus, that ANN with backpropagation algorithm can be used in recognizing a person's face. In general, other things that can be concluded from the analysis carried out, among others : A good sample selection absolutely must be done because it will greatly affect the results while the sample is "A new photo or an old photo but it is not defective or damaged, because if it is defective or damaged, it will be in image processing." will experience difficulties and many possibilities identification failed.

To be able to know whether the int recognition is accurate or not, during training we must also loop the image to be recognized, because by repeating the results of the training we can achieve a high Match level. In the Identification application int data input *GIF is not suitable as input in pattern recognition, that's because *GIF, in its storage, the saved file is too large. The int application program runs on the Windows Operating System, also this application will run slowly if the input relay is too large and can only access *BMP and *JPG format files.

For maximum results, we must also pay attention to the size of the existing photo not to exceed the existing pixel size, in addition to slow loading, the recognition process is not perfect. With results that are more than 60% int, we have not been able to recognize the photo perfectly, so it is necessary to analyze the value level. Match Level by reducing the Error Level value, so that later it can reach 100% match level

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