

# Analysis Implementation Of Artificial Neural Network (ANN) In Character Recognition

S Amalia<sup>1</sup>, A Y Vandika<sup>2</sup>

<sup>1</sup>. Informatics, Computer Science Faculty, Bandar Lampung University, Indonesia.  
sitiamalla231@gmail.com

<sup>2</sup>. Informatics, Computer Science Faculty, Bandar Lampung University, Indonesia.  
arnes@ubl.ac.id

**Abstract.** An artificial neural network is a representation of the 'artificial' of the human brain is always trying to simulate the learning process of the human brain. As nerves are the cells that process information in the brain and form a network as a whole. The term 'artificial' used in neural networks implemented using a computer program that is able to resolve a number of the calculation process during the learning process. An artificial neural network model a structure similar to the human brain. An artificial neural network has been used for image pattern recognition, character, and sound that is always trying to simulate the learning process of the human brain, one it is in the process of *character* recognition. How it works is an input image is converted to form a 10 x 10 matrix is then stored in a *knowledge base* file. The patterns saved earlier will be used as a pattern to be referenced at the time of the test pattern on the computer. The test is performed by comparing the test pattern with the pattern that has been stored on a computer by using ANN. *Optical Character Recognition* (OCR) is an application in pattern recognition to recognize the characters in digital images. OCR applications are already found in *smartphones*, especially the use of Android. Besides adequate hardware specifications for digital image processing, development of *open-source library* for image processing on the Android facilitate the development of software. *Key word* : *Character recognition, OCR, Artificial Neural Network*

## 1. Introduction

### 1.1 Background

Artificial intelligence is one part of computer science that make the engine computer can do the job as human beings and as good as done. At the beginning of creation, the computer is only used as a counting tool only. But along with the development, the role of computers increasingly dominate human life. Computers are no longer just used as a tool to count, but is expected to be empowered to do everything that can be done by humans. So that the computer can act as a human and as well, the computer should also be given the knowledge and have the ability to reason. An artificial neural network is a representation of the 'artificial' of the human brain is always trying to simulate the learning process of the human brain. As nerves are the cells that process information in the brain and form a network as a whole. The term 'artificial' used in neural networks implemented using a computer program that is able to resolve a number of the calculation process during the learning process. An artificial neural network model a structure similar to the human brain. (Character Recognition Using Neural Networks, 2014, Hendri, Kom. M.Kom.)

An artificial neural network has been used for image pattern recognition, character, and sound that is always trying to simulate the learning process of the human brain, one it is in the process of *character* recognition. How it works is an input image is converted to form a 10 x 10 matrix is then stored in a *knowledge base* file. The patterns saved earlier will be used as a pattern to be referenced at the time of the test pattern on the computer. The test is performed by comparing the test pattern with the pattern that has been stored on a computer by using ANN. (Character Recognition Using Neural Networks, 2014, Hendri, Kom. M.Kom.) In the process of character recognition there are methods that can be used algorithms *artificial neural network* (*artificial neural networks*). The algorithm has the advantages that can be implemented into the character recognition. For that I am interested to analysis

character recognition using ANN method entitled "ANALYSIS OF IMPLEMENTATION OF ARTIFICIAL NEURAL NETWORK (ANN) IN CHARACTER RECOGNITION".

## 2. Basis Theory

### 2.1 Literature

To support this research, the authors take a few sources of previous similar studies in doing by previous researchers regarding character recognition (*character* recognition).

#### 2.1.1 Research conducted by Hendri, S. Kom, M. Kom about "Character Recognition Using Neural Networks".

Character recognition is one branch of artificial intelligence. In character recognition, there are several steps that must be passed. Steps must be passed among them is the recognition and pattern matching, pattern recognition the authorities more general, and the last is a *simple character* recognition. *Simple character recognition* is a character class type uppercase and lowercase letters, numbers 10 digits (0-9) and special symbols like a period, exclamation mark, brackets, the symbol of the dollar, the pound and others. Pattern recognition algorithms to extract features and determine the character of the observed to the appropriate class. This algorithm uses sigma notation and matrix in its working procedures.

#### 2.2.2 Subsequent research conducted by the tempest and Agus Adhi Harjoko about "Introduction to Medical Gas Cylinder Series Number Using Neural Networks Back Propagation".

OCR is done to recognize the characters on medical gas cylinders. Characters on medical gas cylinders painted in white or gray on a red background at the top of the tube. Examples of standard serial number are shown in Figure 1, and sample standard serial number is not shown in Figure 2, Figure 3 shows the position of the writing of the serial number on a medical gas cylinder. Character display serial numbers susceptible to noise such as cracking paint on the serial number as well as the background. In addition, there is no serial number written in standard mold that shapes the characters as handwritten characters.



**Figure 1.** Sample Number Series Standard



**Figure 2.** No Standard Sample Serial Number



**Figure 3.** Position Serial Number

Many methods can be used for OCR one with a neural network *back propagation* because it has advantages in addition to high accuracy in recognizing the character is also easy to do optimization for training- so they might be more quickly and generate the desired error. This study designing Android-based system to detect and identify characters in the serial number of medical gas cylinders. This study can be used as a reference in detecting and recognizing the character of the serial number of medical gas cylinders with background noises, the serial number with a variety of colors, and a unique character and can be used to verify the serial number of medical gas cylinders.

#### 2.2.3 Subsequent research by Arifyanto Hadinegoro, Nazaruddin Ahmad, and Suyoto about Application Design "Mobile For The Introduction of Java Script".

Letter character recognition using electronic media is now becoming a very attractive research. Starting from writing character recognition using computer hardware to the communications hardware or gadgets. Various methods are used to conduct this study, and would provide promising results to the advancement of science and the use of media. (Bouridane et al, 2011), conducted research arabic handwritten character recognition using feature extraction. The character data stored in a database that

includes all forms of handwritten Arabic. Both of these techniques are used to create a classification based on the implementation of Neural Networks. The result is the extraction which has a higher level of recognition can be used for handwritten Arabic text. (Fretas et.al., 2007), about the zoning determine alternative strategies for handwriting recognition, fueled by the perception of non-symmetric zoning. This method could be fossilized in the Java application to write akasa which also has a unique design on each article scratches.

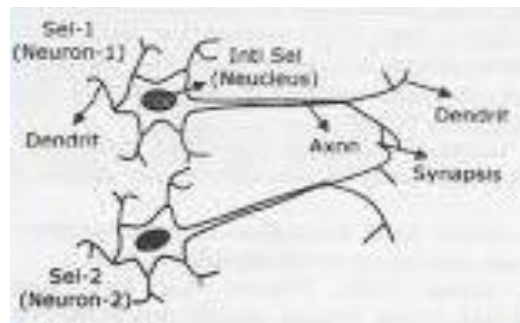
### 3. Results And Discussion

#### 3.1 Results

This section describes the results of several journals and a book that has been read by the author using ANN method, so it will be known the results that have been made to achieve the desired goal or not.

##### 3.1.1 The Human Brain

The human brain contains millions of nerve cells that is responsible for processing information. Each cell works like something simple processor. Each of these cells interact to support the ability of the human brain works.

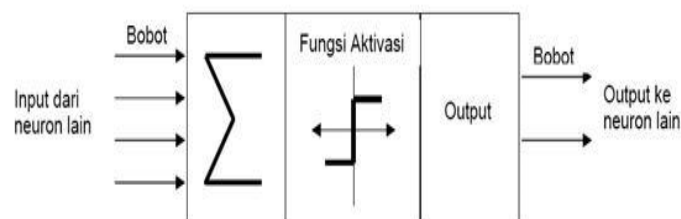


**Figure 4.** Composition of Human Neural

Each nerve cell has a cell nucleus that served to make the processing of information. The information came to be received by the dendrites. In addition to receiving the information, the dendrites also accompany axons as output from an information processing. Information processed will be the input for another neuron dendrites which between the two cells are reunited with synapsis. Information transmitted between neurons in the form of stimulus that is passed through the dendrites. The information came in and received by the dendrites will be totaled and sent via axons to dendrites end in contact with the dendrites of other neurons. This information will be received by other neurons if it meets certain limits or threshold value (*threshold*). Relations between neurons occurs adaptively, meaning that the structure of these relationships occur dynamically. The human brain has always had the ability to learn to adapt. (hal.207-208, Artificial Intelligence, Sri Kusumadewi 2003, ISBN)

##### 3.1.2 Neural Network Components

There are several types of neural networks, but almost all of them have the same components. As well as the human brain, neural networks also consists of some neurons, and there is a correlation between the neuron-neuron. Neurons that will transform the information received through the connection leading to the release of other neurons. In the neural network, this relationship is known as weighting. The information is stored on a particular value in the weights.



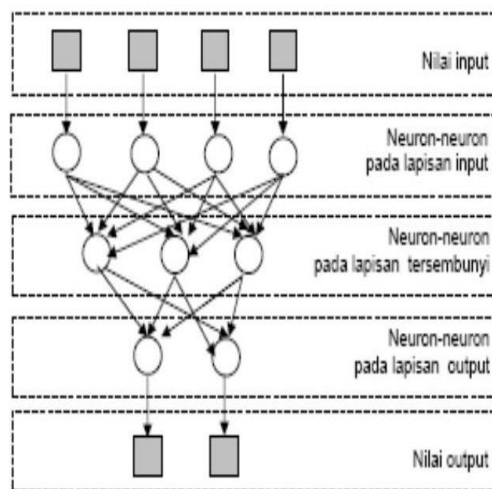
**Figure 5.** Structure of Neural Networks Neuron

Artificial neurons that work the same way with biological neurons. Information (input) will be sent to the neurons with a specific weight of arrival. This input will be processed by a propagation function

which will add up the values of all weights come. The sum is then compared to a threshold value (*threshold*) particular through the activation function of each neuron. If the input is beyond a certain threshold value, then the neurons will be activated, and vice versa. When neurons are activated, then the neuron will send the output via the output weights to all the neurons that relate to him. (page.209210, Artificial Intelligence, Sri Kusumadewi 2003, ISBN)

### 3.1.3 Layer

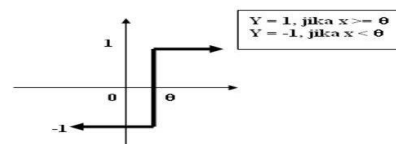
The number of layers used are 3 layers namely layer, *the input* hidden layer and layer. *Output* where in the first layer is a layer for the reduction process which results in the pattern matrix of 10 x 10, the second layer is a hidden layer to the process of pattern matching with the existing *knowledge base* and the third is the output layer in the form of the character of learning out comes and the percentage of similarity with the existing pattern in the *knowledge base*. (Character Recognition Using Neural Networks, 2014, Hendri, Kom. M.Kom.)



**Figure 6.** Layer Three Layer

### 3.1.4 Functions Activation of Bipolar (Threshold)

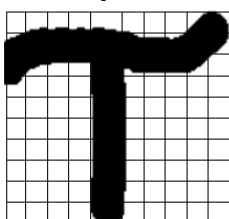
Bipolar function (with a threshold  $\theta$ ) is described as follows:



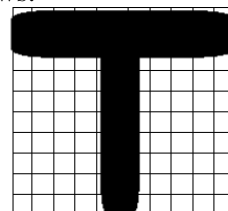
**Figure 7.** function Activation of Bipolar

### 3.2 Discussion

In the test of character with ANNI algorithm which uses a 10x10 matrix to find the percentage similarity, then the distribution of the side edge as follows:



**Figure 8.** Characters Training Data



**Figure 9.** Character Tes Data

In the next phase the examination against the area - an area the intersection based on the x-axis and y-axis between the lines - the lines of the division. If the area of the intersection of black then the values

entered into the matrix is worth 0 (zero). And vice versa, if the white area of the intersection of the value is 1 (one).

1	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1

Figure 10. Reduction Data

1	1	1	1	1	1	1	1	1	0
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	0	0	0	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1
1	1	1	1	0	1	1	1	1	1

Figure 11. Reduction Test Data Training

After getting a pattern of dimension 10x10 matrix, the pattern of test data will be matched with a pattern in the training data. Compare training data patterns with test data. If it finds a pattern similarity is incremented by one, and vice versa, if different, the pattern of similarity is reduced by one. Where the initial state of similarity pattern is 0 (zero).

Vector 1: the training data (1) = 1, test data (1) = 1, similarity = 0 + 1 = 1

Vector 2: training data (2) = 1, test data (2) = 0, similarity = 1-1 = 0

vector 3: training data (3) = 1, test data (3) = 0, similarity = 0-1 = -1

And so on until vector 100 obtained in the following table:

Table 1. Data Matching process

No.	Data Training	Data Uji	Jumlah Kemiripan
1-10	1111111110	1000000001	-8
11-20	0000000000	0000000000	2
21-30	0011000001	1111011111	0
31-40	1111011111	1111011111	10
41-50	1111011111	1111011111	20
51-60	1111011111	1111011111	30
61-70	1111011111	1111011111	40
71-80	1111011111	1111011111	50
81-90	1111011111	1111011111	60
91-100	1111011111	1111011111	70
<b>Total Kemiripan</b>			<b>70</b>

After a total resemblance get as many as 70, then the next step to calculate the percentage similarity.

$$\text{The percentage of similarity} = \frac{70 \times 100\%}{100} = 70\%$$

So the similarity in the percentage can be as much as 70%. If the percentage of similarity is less than 68% then the character needs to be done learning.

### 3.2.1 OCR

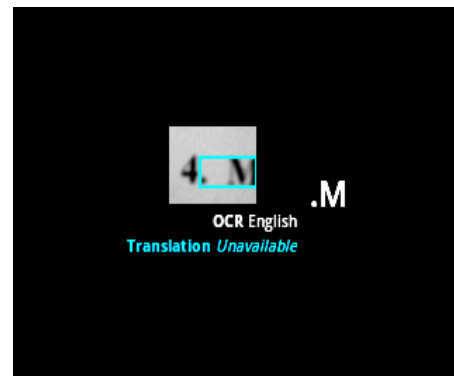
Optical Character Recognition (OCR) is an application in pattern recognition to recognize the characters in digital images. OCR applications are already found in *smartphones*, especially the use of Android. Besides adequate hardware specifications for digital image processing, development of *open-*

source library for image processing on the Android facilitate the development of software. Android application of OCR for instance be used to identify the card and the image of the document. The introduction of the character using the Tesseract engine after preprocessing with adaptive threshold and text orientation detection. Now, OCR research mainly done in order to recognize characters printed with low quality, character types with unique shapes or colors vary, and noise in the image. (Introduction to Medical Gas Cylinder Series No. Using Neural Networks Back Propagation, 2014, Tempest & Agus Adhi Harjoko).

The following results were authors carefully screenshot of android application-ocr-master (OCR-Test) that has been downloaded from github <https://github.com/rmtheis/android-ocr> and <https://github.com/rmtheis/tess-two> to download Tesseract library.



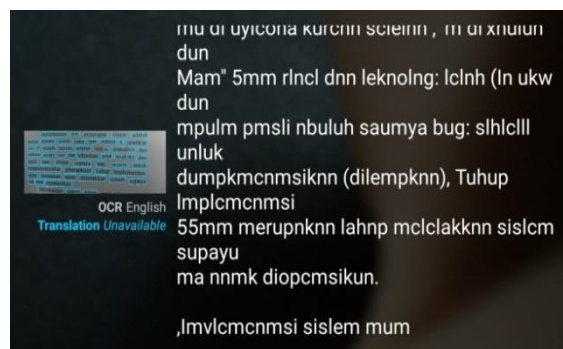
**Figure 12.** OCR-Test Character Legible



**Figure 13.** OCR-Test Legible Most

From Figure 12 above has been read OTG characters that can be recognized by the OCR-Test well.

From Figure 13 above are not all characters can be read properly in OCR-Test. In character 4. M is read only .M only.



**Figure 14.** OCR-Test Character Not Legible

From 14 above that all characters can not be read properly. There are several factors that influence the character recognition in OCR-Test, which is a factor less bright ambient light would make the characters become dark and low-resolution camera factor that will make the characters look blurred or not very clear.

## 4. Conclusions And Recommendations

### 4.1 Conclusion

Based on the analysis and discussion conducted can be summarized as follows:

1. Percentage of similarity can be obtained by comparing the pattern that has been saved once learned by patterns testing by calculating the vector input similarity patterns compared with test patterns obtained divided by the number of patterns compared.
2. The characters that can be recognized by the OCR-Test not all of them can be identified, but there are some characters that can be recognized well.

3. There are several factors that influence the character recognition in OCR-Test, which is a factor less bright ambient light would make the characters become dark and low-resolution camera factor that will make the characters look blurred or not very clear.

#### 4.2 Recommendations

Apart from the contribution that is given, in order to improve further, particularly with respect to methodology research, the author intends to convey some suggestions as follows:

1. In scientific writing about character recognition (*character recognition*) OCR-test not all characters can be recognized, so the authors hope that when building a character recognition application using ANN method to recognize alphabet characters can be recognized by the OCR well and clearly for each character.
2. The authors hope in writing the character comparison is then performed using other methods that are more complex.
3. The author hopes that this paper can be a source / reference for other writing which write about the introduction of the character in the search for similarity percentage.

#### References

- [1] Hadinegoro, Arifiyanto, Nazaruddin Ahmad and Suyoto. *Mobile Application Design 2013. For the introduction of Java script*. Sentika. Yogyakarta, March 9th, 2013 [https://fti.uajy.ac.id/sentika/publikasi/makalah/2013/2013\\_10.pdf](https://fti.uajy.ac.id/sentika/publikasi/makalah/2013/2013_10.pdf). (15 December 2016).
- [2] Hendri. 2014. *Character Recognition Using Neural Network*. JurnalTIMES. **Vol. III** No. 2: 1-5, 2014. Taken from: <http://www.stmiktime.ac.id/ejournal/index.php/jurnaltimes/article/download/17/13>. (7 November 2016).
- [3] Kusumadewi, Sri. 2003. *Artificial Intelligence (Techniques and Applications)*. Yogyakarta: Graha Science.
- [4] Tempest, Adhi, and Agus Harjoko. 2014. *Introduction of Medical Gas Cylinder Serial Number Using Back Propagation Neural Network*.
- [5] IJEIS. **Vol. 4**, No. 2, October 2014. Taken from: <https://journal.ugm.ac.id/index.php/ijeis/article/view/7122>. (25 November 2016)
- [6] Pali, Pritesh A., and Anjusha Pimpalshende. 2013. *A Neural Network Approach to Character Recognition*. IJSR. **Volume 4** Issue 3, March 2013. Taken from: <https://www.ijsr.net/archive/v4i3/SUB151936.pdf>. (5 December 2016).
- [7] Subriyanto, Eko Arie. 2013. *Sekilas Jaringan Saraf Tiruan*. from: <https://ekoariesubriyanto.wordpress.com/2013/01/11/jaringan-syaraf-tiruan/>.(February 2, 2017).