■ 1697

# The Development of Javanese Language Teaching Materials Through Introduction of Java Scripts Using Artificial Neural Network

**Siswo Wardoyo\*[1], Kuntari W[2], Anggoro S. Pramudyo[3], Suhendar[4], Syarif Hidayat[5]**
[1,2,3,4]Department of Electrical Engineering, Universitas Sultan Ageng Tirtayasa, Indonesia
Jl. Jenderal Sudirman Km 3 Cilegon 42435, Indonesia telp/fax: +62-254-376712 (ext 20)/ +62-254-395440
[5]SMA Muhammadiyah 3 Yogyakarta, Jl. Kapten Piere Tendean No.58, Wirobrajan, Yogyakarta,
55252, Indonesia
\*Coressponding author e-mail: siswo@untirta.ac.id

## Abstract

*The Java script is a traditional Indonesian scripts known as Hanacaraka or Carakan. Java script becomes less desirable students who have not been introduced by Master to students using interesting digital media. Javanese language teachers in teaching activities do not yet have interactive learning media in making Java script. This research aims to develop digital media recognition Java script using artificial neural network back propagation method as a teaching material of Java language. The sample of research used is basic java script which consist of 20 characters. The method of extraction properties used is Fast Fourier Transform, which is sampled horizontally and vertically. The result of this research showed FFT and ANN can be made of interactive learning media. The effectiveness of system with sensitivity value of 0,046 - 0,085, specification value 0,023 - 0,052, and system reliability is 59,5%. Validation value system that has been built for pattern recognition Java script on the training process is 100%, the testing process with the data $-3^o$ rotation, $-1^o$, $+1^o$, $+3^o$ reaches 100%, for a rotation $-5^o$ testing data, and $+5°$ is 80%, testing of handwritten data is 65%, the test data $+10^o$ rotation is 25%, the test with the data translation is 5%, and for testing with the data and the data of rotation $+90°$ zoom in (view) is 0%.*

*Keywords: Java script; Interactive learning; Digital media; Teaching material; Artificial neural network*

## 1. Introduction

Currently among 726 ethnic languages spoken in Indonesian archipelago, 146 are endangered [1]. Javanese language had a long history of its development. Based on the evidence in the form of inscriptions and paleography, the earlier stage of Javanese script was started before the eight century [2]. Javanese transcription is called Hanacaraka Scripts. It's consists of 20 basic scripts called Carakan, including 20 consonants and 1 vowel. Hanacaraka script shown in Figure 1. Java script or better known as Hanacaraka or Carakan is derived from Brahmi script originating from India. Use of this script has been used since the Sultanate of Mataram (17th century), but the new print form is found in the 19th century [3]. Java script characters is a complex pattern of characters. The character patterns have many similarities between each individual character, so its use is not as easy as the Latin alphabet.

In another research about Javanese character recognation using backpropagation neural network explored in [4]. Publication [5] showed a technique based on Fast Fourier Transform (FFT) basic principle can feature extraction pattern of characters using decomposition calculation of Discret Fourier Transform. The basic task of feature selection and extraction is how to find out the most important characteristics from many features [6]. Publication [7],[8],[9], showed the artificial neural network (ANN) can be used for recognition of image pattern and handwriting.

The main problem of Java script less popular in student is difficulty used a digital media in classroom. According publication [4], [5] and [9], the colaboration FFT with ANN can build a digital media for teaching materials in classroom. So in this research to build digital media for identify the pattern of basic Java script by fourier transform and artificial neural network (ANN). Thus, with digital media of built, recognation of javanese scripts, it can will be quickly resolved.

Figure 1. Basic Java script

## 2. Research Methodology

This research uses some activities to obtain the goals to be achieved. The methodology of this research is the research and development (R&D) of software systems. Input image is used for pattern recognition Java script is divided into two, train image data of 120 images, and the test image data of 20 images for each experiment. Training image is made of with Pallawa application, and the application of papyrus [7]. The details of the training image data is 6 images for each character Javanese script. The image data testing is one image for each character Javanese script, where the Javanese script code consists of 20 characters.

Pre-processing the image, the first is process of data acquisition input, where in the input image in the crop, and resize to a size of 128x128 pixels. Background used is white with a black object Javanese script. The next process is the binerisation process, namely the separation of pixels based on degree of gray image. Javanese script image data used in this research has grayscale 256 degrees, so that the middle value is 128, which if the image is converted into a binary image, can be written:

*If x < 128 then x = 0, if not then x = 1*

The next image pre-processing is a complement or invert image from binerisation result. In this process the image of the previous Javanese script on a white background with black object color, reversed into a black background and the object color to white. The next process is the process of finding the image profile, serves to get a count of pixels whose intensity 1 which is the object representation of Java script (white one). Profile image obtained by reading pixels are owned object, and adds value to the image profile 1 every time they met pixels belonging to the object. Readings profile image meets with the background, the image profile value is not added to 1, or fixed-value of 0. The search process is carried profile image horizontally and vertically.

A Feature extraction methods used in this research is the Fast Fourier Transform [5]. The next step in the process of feature extraction is the process of normalization of data from the Fourier transformation, normalization results are then sampled to accelerate computing process.

The next stage is training process. The training process using 6 image of each character Java script, the image is a normal image, rotation image -4°, -2°, + 2°, + 4° of applications Pallawa, and handwritten image with the application papyrus. The process of training by backpropagation network requires several parameters that need to be set up to research the function traingdx.

The testing process is performed to determine the level of success of a network to recognize the pattern of the new input, the process of testing to compare the value of all output to the target. The testing process is done 11 times of testing. The first testing with Java script image from the application Pallawa who have undergone surgery process rotated images -5°, -3°, -1°, + 1°, + 3°, + 5°, + 10°, + 90°. The next testing with Java script image from Pallawa applications that have undergone a process of linear operations are translated image. Third

testing with Java script image from the application Pallawa who have undergone surgery process the image to zoom in (enlarge) 2 times, and last testing with Java script image handwritten on papyrus application.

Based on the results of training and testing that has been done in the research, to determine the accuracy of the performance of the system, then held a statistical approach is related to the effectiveness of this system, in order to obtain each of the four values are true positive (TP), false positive (FP), false negative (FN), and true negative (TN). Based on these four values, the value of TPR which is known as sensitivity in equation 1. FPR or spesificity by equation 2, while a value that indicates the accuracy of identification (accuracy) is obtained from equation 3.

$$TPR = \frac{TP}{TP+FN} \tag{1}$$

$$FPR = \frac{FP}{FP+TN} \tag{2}$$

$$Accuracy = \frac{TP+TN}{TP+FP+TN+FN} x100\% \tag{3}$$

## 3. Results and Analysis

The process of the first pre-processing is performed binerisation image from original image. The next process is the complement of the image or invert the image, in this process the color of objects previously Java script is black with a white background, reversed into a Java script object is white and black background. The result of the pre-processing (two process) shown in Figure 2.



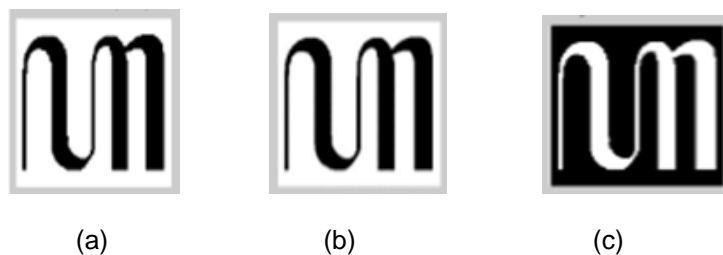(a)                    (b)                    (c)

Figure 2. (a) input image, (b) binary image, (c) complement of a binary image

After the complement of binary image, the next stage in the process of pre-processing image is search profile of image. This stage to seek representation on Java script object horizontally and vertically. The result of the pre-processing search profile of image shown in Figure 3. Profile image obtained by reading pixels are owned object, and add value to the image profile 1 every time they met pixels object. Readings profile image meets with the background, the image profile value is not added to 1, or fixed-value 0.

Feature extraction of Carakan scripts by using the Fast Fourier Transform method in horizontal and vertical. The result of the feature extraction carakan script shown in Figure 4 and 5. The next step is process of normalization data from the Fourier transform taken magnitude only, while the imaginary part is not taken into account, then make the maximum magnitude value as a divisor factor on the magnitude of the existing value, so that the maximum value of each characteristic patterns of each Java script is worth 1. The result of the normalization is then sampled to speed of computing process. The process of horizontal and vertical sampling is done every 3 pixels of 128 pixels, the total sampling is 86 as input into the neural network.

Terms which also determines the cessation of backpropagation network formation process, these include the achievement of maximum iteration, MSE value has been reached, the minimum gradient value has been reached, and also validation check that has been fulfilled. The training process stop because the MSE or goals that have been set has been reached, that

is $10^{-5}$, with the epoch or iteration to 1742, and the gradient of $3.34 \times 10^{-6}$, the training process is stalled at 25 second.
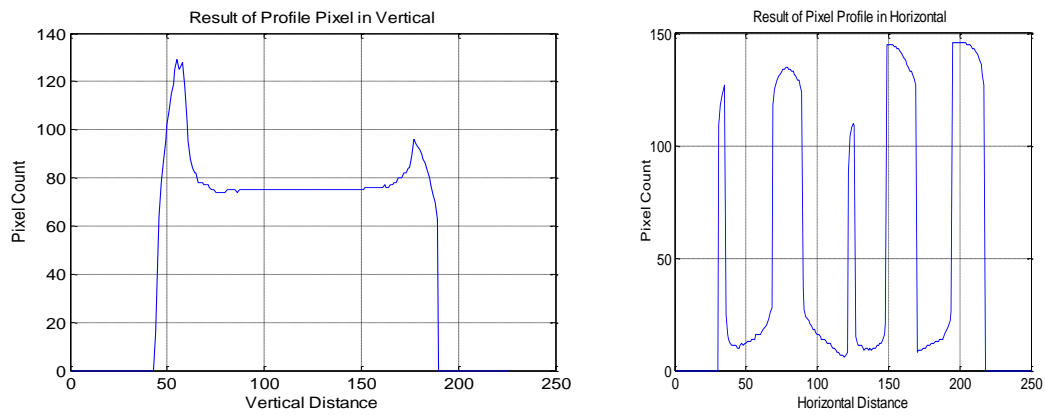
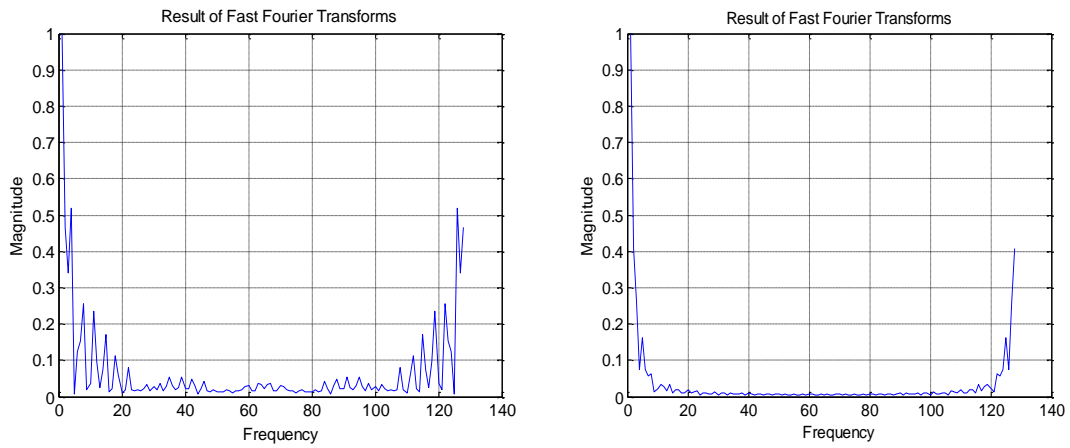Figure 3. Sampling results in horizontally and vertically of image profile

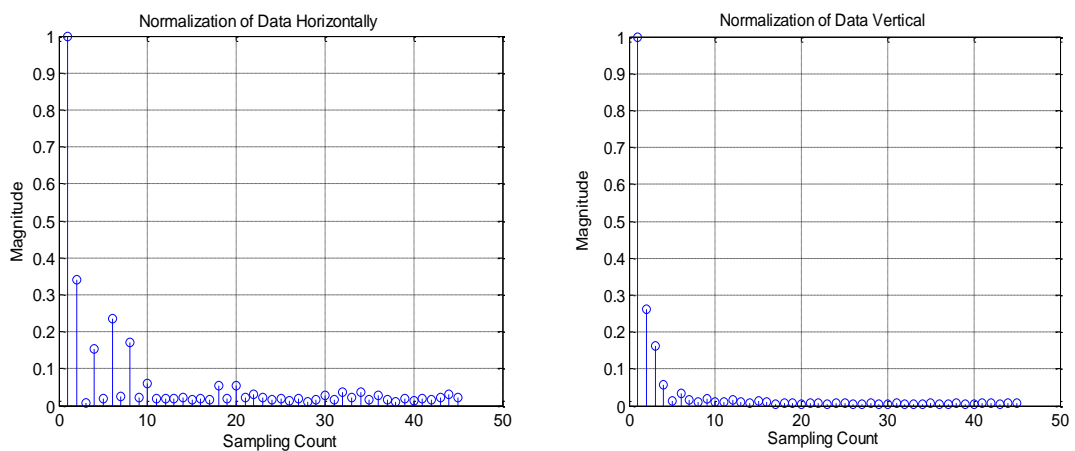Figure 4. Results of Fast Fourier transform horizontal and vertical

Figure 5. Results of data sampling Java script horizontal and vertical

Comparison with the output targets training data, the amount of training data is 120 image with each of 6 images for each character can be recognized all Java script, is seen from the sign (*) as output training data network overlapping to the target (o) which has been determined. Six images from any Java script that is used for training data is a normal image, image rotation -4°, -2°, +2°, + 4° from applications Pallawa, and handwritten image from papyrus application. Value validation system for the training process are:

$$\text{Validation} = \frac{120}{120} \times 100\% = 100\%$$

Testing in Java script pattern recognition is performed 11 times of testing, testing with Java script image from the application Pallawa who have undergone surgery process rotated images -5°, -3°, -1°, + 1°, + 3°, + 5°, + 10°, + 90°, the tests with the image of a Java script Pallawa applications that have undergone a process of linear operations are translated image 1 inch to the axis of x, y, testing with Java script image from the application Pallawa who have undergone surgery process the image to zoom in (enlarge), and testing with Java script handwritten image of papyrus application. The test is performed as a medium to see how good backpropagation network that has been built for this Java script pattern recognition.

Table 2 is a Java script pattern identification data of all the testing that has been done, the number 1 represents a Java script that successfully identified, and the number 0 represents a Java script that is not successfully recognized by backpropagation system that has been built. Value validation for testing of the 2nd through 5th is 100%, for the testing of the 1st and 6th is 80%, for testing the 7th is 25%, for testing the 8th and 10th is 0%, for testing the 9th is 5%, to test the 11 is 65%.

Effectiveness of pattern recognition system can be seen from the value of sensitivity (TPR), specificity (FPR), and accuracy. Java script identification HA, CA, DA, TA, LA, JA, YA, GA, THA sensitivity values obtained for 0076, with a specificity value of 0.031. Java script NA, RA, SA, MA sensitivity values obtained for 0085, with a specificity value of 0.023. Java script KA, PA, DHA, sensitivity values obtained for 0067, with a specificity value of 0.038, for Java script NYA, BA sensitivity values obtained for 0056, with a specificity value of 0.045, and for the Javanese script WA, NGA sensitivity values obtained for 0046, with a specificity value of 0.052 accuracy value system of identification for all tests was 59.5%. Results of the effectiveness of the system for all Java script as shown in Table 3.

Table 2. Results of the identification of patterns of Java script

| Java Script | Testing | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -5° | -3° | -1° | +1° | +3° | +5° | +10° | +90° | Translasi | zooming | Handwritten |
| HA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| NA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| CA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| RA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| KA | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| DA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| TA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| SA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| WA | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| LA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| PA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| DHA | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| JA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| YA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| NYA | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| MA | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 |
| GA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| BA | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| THA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| NGA | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 3. Results of the effectiveness of the system for all Java script

| Java Script | Effectiveness of the system | | | | TPR | FPR | % |
|---|---|---|---|---|---|---|---|
| | TP | FP | TN | FN | | | |
| HA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| NA | 8 | 3 | 123 | 86 | 0.085 | 0.023 | 59.5% |
| CA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| RA | 8 | 3 | 123 | 86 | 0.085 | 0.023 | 59.5% |
| KA | 6 | 5 | 125 | 84 | 0.067 | 0.038 | 59.5% |
| DA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| TA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| SA | 8 | 3 | 123 | 86 | 0.085 | 0.023 | 59.5% |
| WA | 4 | 7 | 127 | 82 | 0.046 | 0.052 | 59.5% |
| LA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| PA | 6 | 5 | 125 | 84 | 0.067 | 0.038 | 59.5% |
| DHA | 6 | 5 | 125 | 84 | 0.067 | 0.038 | 59.5% |
| JA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| YA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| NYA | 5 | 6 | 126 | 83 | 0.056 | 0.045 | 59.5% |
| MA | 8 | 3 | 123 | 86 | 0.085 | 0.023 | 59.5% |
| GA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| BA | 5 | 6 | 126 | 83 | 0.056 | 0.045 | 59.5% |
| THA | 7 | 4 | 124 | 85 | 0.076 | 0.031 | 59.5% |
| NGA | 4 | 7 | 127 | 82 | 0.046 | 0.052 | 59.5% |

## 4. Conclusion

Feature extraction method using a scanning method profile image horizontal and vertical of each image is transformed with Java script Fast Fourier transformation can be used to determine the characteristics of each character pattern Java. The feature can be used as the basis for identifying patterns of characters Java.

Validation value system that has been built for pattern recognition Java script on the training process is 100%, the testing process with the data -3$^o$ rotation, -1$^o$, +1$^o$, +3$^o$ reaches 100%, for a rotation -5$^o$ testing data, and +5° is 80%, testing of handwritten data is 65%, the test data +10$^o$ rotation is 25%, the test with the data translation is 5%, and for testing with the data and the data of rotation +90° zoom in (view) is 0%.

Java script identification HA, CA, DA, TA, LA, JA, YA, GA, THA sensitivity values obtained for 0076, with a specificity value of 0.031. Java script NA, RA, SA, MA sensitivity values obtained for 0085, with a specificity value of 0.023. Java script KA, PA, DHA, sensitivity values obtained for 0067, with a specificity value of 0.038, for Java script NYA, BA sensitivity values obtained for 0056, with a specificity value of 0.045, and for the Java script WA, NGA sensitivity values obtained for 0046 , with a specificity value of 0.052 accuracy value system of identification for all tests was 59.5%. Further research is needed to support the system to be reliable, beyond the current research carried out primarily for the development of learning media. Hopefully the goal to introduce more Java letters to students can be easily implemented.

## Acknowledgments

## References

[1] S Sakti, S Nakamura. Recent Progress In Developing Grapheme-Based Speech Recognition For Indonesian Ethnic Languages : Javanese, Sundanese, Balinese And Bataks. in *SLTU-2014*. 2014: 14–16.
[2] JG. de Casparis, Indonesian Palaeography: A History of Writing in Indonesia from the Beginnings to CAD 1500. 1975; 4.
[3] VI Ekowati. *Javanese Letters: Symbols Of Javanese Civilization: (Introductio N, History, Philosophical Values, Learning Methods, Utilizations, To Uch Of Technology In Javanese Letters)*. 1st Mae Fah

Luang University International Conference, 2012; 1975: 1–10.

[4] ASAS, Nurmila NE. Back propagation neural network algorithm for java character pattern recognition. *J. Masy. Inform.*, 2010; 1(1): 1–10,.

[5] S Wardoyo, AS Pramudyo, ED Rizanti, I Muttakin. Exudate and Blood Vessel Feature Extraction in Diabetic Retinopathy Patients using Morphology Operation. *TELKOMNIKA (Telecommunication Comput. Electron. Control)*. 2016; 14(4): 1493–1501.

[6] B Rubbings. Characters Feature Extraction based on Neat Oracle. *TELKOMNIKA (Telecommunication Comput. Electron. Control)*. 2013; 11(9): 5427–5434.

[7] M Sudarma, S Ariyani, M Artana. Balinese Script's Character Reconstruction Using Linear Discriminant Analysis. *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS)*. 2016; 4(2): 479.

[8] A Pal, D Singh. Handwritten english character recognition using neural network. *Int. J. Comput. Sci.* 2010; 1(2): 141–144,.

[9] GS Budhi, R Adipranata. Handwritten Javanese Character Recognition Using Several Artificial Neural Network Methods. *J. ICT Res. Appl*, 2015; 8(3): 195–212.