Implementation of Backpropagation Method for Identified Javanese Scripts

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Abstract. Literacy is one important component in a culture, one of which is Javanese culture. Javanese script is used as the main script that is used daily by most people in Central Java. Along with the development of human civilization and the expansion of global life, Javanese script began to be abandoned, even by the Javanese themselves. The use of Javanese characters is reduced because of the difficulty of learning Javanese characters themselves. Java character sets consist of basic characters, numbers, complementary characters, and so on. Javanese script is a traditional Indonesian script known as Hanacaraka or Carakan. Backpropagation is a systematic method of artificial neural networks using supervised learning algorithms and is usually used by perceptron with multiple screen layers to change the weights in the hidden layer. Text recognition application in alphabetical letters with neural networks. In the research we made, the training results of this application are good, because it can recognize letters well, the maximum characters that can be read by the application are 128 characters [Latin characters], based on ASCII code pages, this text recognition application can recognize letters and numbers, namely AZ and 0-9 with a percentage of success of up to 90%, Input characters to teach on the form train can only teach 1 character only.

1. Background

Today's computer-based learning media has developed very rapidly, many applications are created and developed to support the learning process to be interactive for example is the application of digital image processing And applications that use artificial neural network methods. This digital image processing includes character recognition techniques such as alphanumeric characters, handwritten characters, starch characters, etc. This character recognition technique is generally known as technology OCR (Optical Character Recognition). Artificial neural networks are information processing systems that have characteristics similar to human neural networks. The learning model needs to be done on an artificial neural network before it is used to solve problems by checking and correcting any errors that occur during the learning process. At a certain level, artificial neural networks can provide the correct response even though the input given is noise or changes by a situation. The advantage of artificial neural networks is the ability to recognize by learning from the pattern of images taught. In the many providers of image pattern recognition, there is still a lack of pattern recognition in the Javanese script.

Where Javanese script is one of the priceless cultural relics. The form of the script and the art of making it become a legacy that deserves to be preserved. Not only in Java, but this Javanese script is apparently also used in the Sunda and Bali regions, although there is indeed a slight difference in writing actually the characters used are the same. In Javanese society, Javanese letters are cultural heritage used to write literary works written in books, ancient Javanese texts, Javanese songs, inscriptions, or in correspondence in court circles and royal affairs.

Figure 1. Basic Java script

2. Study Literature

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 [1]. 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 grey image. 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 colour, reversed into a black background and the object colour 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.

3. Methods

Image processing is a process of image processing and analysis that involves a lot of visual perception [2]. This process has the characteristics of input data and output information in the form of images. The term digital image processing is generally defined as two-dimensional image processing with a computer. In a broader definition, digital image processing also includes all two-dimensional data [2].

3.1 Character Encoding

Is a method to pair a character with something natural symbol. The natural symbol in question can be in the form of numbers, letters or even electric pulses. The purpose of the character encoding process is to facilitate the storage of text on a computer or sending the text through telecommunications networks.

An example of this kind of coding process is Morse code, which pairs Latin with a long or short Morse signal.

3.2 Unicode

Conducting Unicode reasoning is an industry-standard designed to encode universal characters used to represent text in computer processes. Unicode provides a consistent way to encode various languages. The purpose of this standard is to facilitate computer users when dealing with texts from various languages. In addition, computer users who use various mathematical symbols or other technical symbols will be greatly facilitated by the use of Unicode standards.

3.3 Backpropagation

Is a systematic method of artificial neural networks using supervised learning algorithms and is usually used by a perceptron with many layers of screen to change the weights in the hidden layer. Backpropagation is a controlled type of training which uses a weight adjustment pattern to achieve the minimum error value between the predicted output and the actual output.

3.4 Feed-Forward Artificial Neural Network

Based on the architecture connection pattern, artificial neural networks are divided into two categories namely Feed-Forward Structure and Feed-Back Structures. In this Final Project the structure used is feed-forward, in this type of network the signal moves from the input then passes through the hidden layer and finally reaches the output unit has a stable behaviour structure.

4. Result and Discussion

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 colour 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.
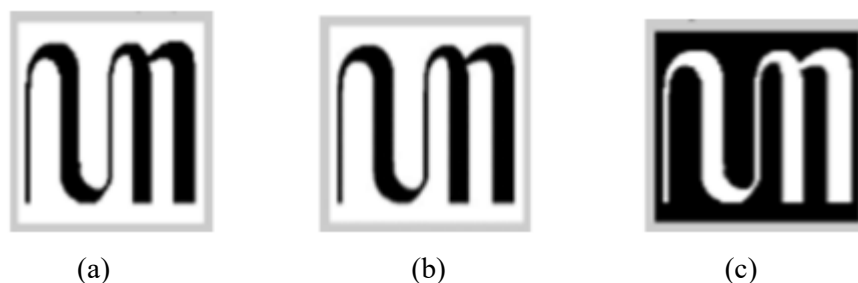
(a)   (b)   (c)

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 2 at a. 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 2 at b and c. 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.

With a morphological approach, we view an image as a set of positions (x, y) that have a value of 1 or 0 [3]. Morphological operations are operations that are used to improve shape making it easier to recognize [4]. In general, image processing in morphology is done by passing a structuring element to an image in a manner similar to convolution. Structuring elements can be likened to masks on ordinary image processing [5]. Filter operations are classified as morphological operations, namely: [6], [6]

a. Dilation: is the process of combining background points [0] into part of an object [1], based on structuring element S used.

b. Erosion: is the process of removing object points [1] to be part of background [0], based on structuring element S used [7]. Operations that can produce pixel output in images with objects that tend to be reduced thinning [8], Erosion operations will reduce the original image smaller than the structural element.

c. Opening: Erosion surgery followed by dilation is to clarify the appearance of the image, connect disconnected features, and heighten the peak in the image [9].

d. Closing: Dilation operation followed by erosion, is to clarify the appearance of the image, break the features that are connected, and enhance the peaks in the image [10].

4.1 Threshold

Threshold is the simplest method of image segmentation. From the grayscale image, thresholding can be used to form a binary image. Variants include also the threshold below where the opposite of the threshold above. Threshold inside, where a pixel is labelled "object" if the value is between two threshold values and the outside threshold where it is the opposite of the threshold inside. Usually, the pixel object is given a value of 1 while the background pixel is given a value of 0. The key parameter in the thresholding process is the selection of the threshold value.

A recent approach is to form a histogram of pixel intensity and use the valley point as a threshold value. The histogram approach assumes that there is an average value of the background pixel and pixel object, but that the actual pixel value has a variation between the average values. A method that is relatively simple does not require specific knowledge of an image and is strongly against image noise is the iterative method as follows:

1. A threshold value [T] is selected, this can be done randomly or based on the desired method.

2. The segmentation image based on the pixel object and background as described above forms two sets:
   a. $G1 = \{f[m,n]:f[m,n]>T\}$ [object pixels]
   b. $G2 = \{f[m,n]:f[m,n] T\}$ [background pixels] [note, f[m,n] is the value of the pixel located in the mth column, nth row]

3. The average value of each set is calculated; m1 = average value of G1, m2 = average value of G2, a new threshold value is formed as the average value of m1 and m2.

   T' = [m1 + m2]/2

4. Back in step 2, now using the new threshold value computed in step four, keep repeating until a threshold value is equal to the previous value until convergence is fulfilled.

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4.2 Process Flow of the Backpropagation Algorithm

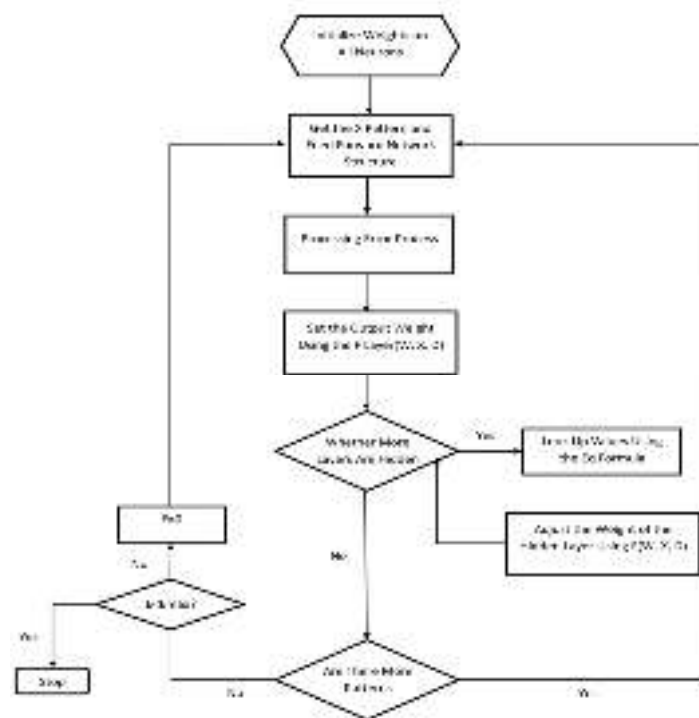This text recognition application uses the backpropagation algorithm.

Figure 3. Flowchart Backpropagation Algorithm

5. Summary

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 -3o rotation, -1o, +1o, +3o reaches 100%, for a rotation -5o testing data, and +5° is 80%, testing of handwritten data is 65%, the test data +10o 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.

6. References

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