Application of Neural Network in Letter Recognition Using the Perceptron Method

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Abstract
Modeling with neural networks is the learning and adjustment of an object. The perceptron method is a learning method with supervision in a neural network system. In designing a neural network that needs to be considered is the number of specifications that will be identified. A neural network consists of a number of neurons and a number of inputs. To identify some letters, it takes several neurons to distinguish them. These neurons will generate a combination value that is used to identify the letters. So that the resulting network must have parameters that can be set by changing through the rules of learning with supervision. Image pattern recognition will be mapped into grids, where each black grid is assigned a value of 0 and a white grid is assigned a color of 1. The percentage of similarity of image pattern recognition with a 100% similarity level.

Keywords: Perceptron Method, Neural Network, Letter Recognition

INTRODUCTION
Handwritten letter recognition is a form of pattern recognition. Problem solving for various handwriting will be closely related to pattern recognition which aims to generate and select patterns that can be used at the time of identification [1]. Nowadays, electronic documents are often found which are processed using computers. Documents are packaged in various formats according to the application used, such as DOC, PDF or JPG formats [2]. There are several methods of processing electronic documents, one of which is by scanning the original document which will be processed into an electronic document in JPG format. This method is the fastest and most practical way, and the output is also 100% the same as the original document. However, the resulting electronic document cannot be re-edited, because the resulting document is in the format of an image. To be able to edit electronic documents in this format, they must be converted into an editable format, such as DOC or PDF format. The problem that arises is, how to change the format of the electronic document so that it can be re-edited. To solve the above problem, The author wishes to design a software that can recognize characters in an electronic document and convert them into text with a higher level of accuracy. The method used in this study is the perceptron network model [3].

Perceptron is one of the recognition methods that are often used in artificial neural systems or artificial neural networks. Perceptrons are usually used to classify certain types of patterns which are often known as linear separations [4]. Computers must have their own algorithms or ways, the ability of computers to recognize patterns is starting to be widely used to solve various problems [5]. ANN adopts 5 aspects of human ability, namely:
Memorization, Generalization, Efficiency, Accuracy, and Tolerance in its application [6]. The handwritten number pattern on a check is a very diverse thing [7]. One of the applications of artificial neural networks is in recognizing Russian letter patterns (Silirik alphabet) [8]. The software designed will use a neural network by utilizing the perceptron method in recognizing these characters [9]. The author chose the perceptron method because this method can be used to classify whether a pattern enters a class or not [10]. This method is also able to classify a pattern into which class, by comparing the pattern into each existing class. By designing class patterns based on letter characters, a character pattern detection software will be produced in an electronic document that has a high level of accuracy. Because of these advantages, ANN can be used to recognize certain patterns, in this study arithmetic notation patterns [11]. Neural Network Method Perceptron algorithm is a method that is able to perform the calculation process by recognizing the variables in pattern matching and in the end the output from the network can be used as consideration for decision making [12].

**METHODS**

**Perceptron Method**
Perceptron is a single layer learning algorithm that learns a procedure by looping until it gets the right neural weight. The Perceptron Learning Algorithm is better than the Hebb rule algorithm [13]. Perceptron uses binary activation functions for sensor units and association units and uses +1, 0, -1 activation for unit responses. The purpose of learning rules is to train the network to perform some task. There are many types of neural network learning rules. They are divided into 3 big categories [14]: supervised learning, unsupervised learning and unsupervised (or assessed) reinforcement learning (reinforcement learning) [15].

Based on the analysis that the author did on the work process of the perceptron method in doing this letter pattern recognition, the advantages of this method are:
1. *Perceptron* is a method that uses a matrix pattern in recognizing letter patterns. This causes the recognition results to be accurate because by using a matrix, we can compare the X and Y coordinate values of an image pixel that will be recognized by letter patterns in the database.
2. *Perceptron* does not require complex calculation algorithms so that it is suitable to be applied to almost all programming languages, even programming languages that do not have complete arithmetic support facilities.
3. *Perceptron* have a tolerance level for error. This causes the recognition accuracy level to remain high even though the inputted digital image has a little damage so that there are some parts that cannot be recognized properly.

**Neural Network**
Testing the Artificial Neural Network (ANN) Method with seven design variables[16]. Sensory neurons, also known as afferent neurons, are neurons that carry nerve impulses. The ends of the dendrons (long dendrites) of some sensory neurons form receptors throughout the body, which transmit impulses to neurons when stimulated. Then the receptors will be connected and deliver impulses to the human brain through several sensory neurons [17].

**Artificial Neural Network**
An artificial neural network (ANN) is one of the machine learning algorithms that imitates the workings of the neural network of living things. An artificial neural network is a network of many small processing units (called neurons) each of which perform simple
processes, which when combined produce complex behavior [18]. Characteristics of Artificial Neural Networks In general, the characteristics of an artificial neural network are as follows:
1. Inputs can be discrete or real values that have multiple dimensions
2. The output is a vector consisting of several discrete or real values
3. Can study problems in black box, by only knowing the input and output values.
4. Able to handle learning of data that has noise (noise)
5. The shape of the learning target function is unknown, because it is only in the form of the weights of the input values for each neuron.
6. Because they have to change a lot of weight values in the learning process, the learning time becomes long, so it is not suitable for problems that require fast time in learning.
7. Artificial neural networks resulting from artificial learning can be run quickly.

RESULTS & DISCUSSION

Letter pattern recognition system with perceptron method is a system that aims to recognize letter patterns from a digital image. Broadly speaking, this recognition system goes through the following processes:

Preprocessing Stage
At this stage, the pattern of letters and numbers is inputted, such as AZ, az and 0-9. This pattern is then stored in a database that will be used as a comparison material in the next process. For example, a pattern of the letter "A" will be input to be stored in the database.

![Figure 1: Example of Letter Pattern Input](image)

This inputted letter will be converted into an image, then resized to a size of 30 X 30. After that, this image will be mapped into grids, where each black grid is assigned a value of 0 and a white grid is assigned a value. color 1

![Figure 2: Mapping results in the form of a grid](image)
Then, the mapping results in the form of a grid will be stored into the database in the form of a matrix based on the row (x) and column (y) positions of the mapping results. When storing the results of this mapping into the database, the system will store the identity of the letter pattern that will be used to recognize the inputted letter pattern. Next, this letter will be resized in size 30 X 30 and mapped into grids and assigned a rating for each grid, where for the white grid the value is 1 and the value 0 for the black grid.

![Figure 3: Letters to be recognized in the form of a grid](image)

**New Character Pattern Input Test**

The purpose of this testing phase is to ensure that the designed software can accept input of new character patterns that will be used as reference material in letter pattern recognition. For this reason, the author inputs three letter patterns to be recognized, namely A, B and C. For training the introduction of the letter "A", the author writes the shape of the letter "A" on the input media provided.

![Figure 4: Testing the “A” Letter Pattern Recognition Training](image)

After that, the author presses the Train button. The results obtained are the emergence of information that the letter recognition was successful as shown below.
Figure 5: Results of the “A” Letter Pattern Recognition Training

For training the introduction of the letter "B", the author writes the shape of the letter "B" on the input media provided.

Figure 6: Testing the “B” Letter Pattern Recognition Training

After that, the author presses the Train button. The results obtained are the emergence of information that the letter recognition is successful.
Figure 7: Results of the “B” Letter Pattern Recognition Training

For training the introduction of the letter "C", the author writes the shape of the letter "C" on the input media provided.

Figure 8: Testing the “C” Letter Pattern Recognition Training
After that, the author presses the Train button. The results obtained are the emergence of information that the letter recognition is successful.

![Figure 9: Results of the “C” Letter Pattern Recognition Training](image)

**Letter Pattern Recognition Test**

The purpose of this testing phase is to ensure that the software designed has been able to perform letter pattern recognition based on the input letter patterns and the results of comparisons with the character pattern database that has been prepared. For this reason, the author uses three letter patterns that he will try to identify, namely the letters "A", "B" and "C". For training the introduction of the letter "A", the author writes the shape of the letter "C" on the input media provided.

![Figure 10: Testing the Recognition of the Letter Pattern "A"](image)
After that, the author presses the Recognize button. The results obtained are the emergence of information that the letter pattern has been successfully recognized, which is indicated by the appearance of the percentage of letter matches with one of the characters stored in the database.

Figure 11: Results of the Letter Pattern Recognition "A"

In training the introduction of the letter "B", the author writes the shape of the letter "B" on the input media provided.

Figure 12: Testing the Letter Pattern Recognition “B”
After that, the author presses the Recognize button. The results obtained are the emergence of information that the letter pattern has been successfully recognized, which is indicated by the appearance of the percentage of letter matches with one of the characters stored in the database.

Figure 13: Results of the Letter Pattern Recognition “B”

For training the introduction of the letter “C”, the author writes the shape of the letter “C” on the input media provided.

Figure 14: Testing the Recognition of the Letter Pattern “C”
After that, the author presses the Recognize button. The results obtained are the emergence of information that the letter pattern has been successfully recognized, which is indicated by the appearance of the percentage of letter matches with one of the characters stored in the database.

![Figure 15: Results of the Letter Pattern Recognition “B”](image)

**Character Pattern Training Results Storage Test**

The purpose of this testing phase is to ensure that the software designed has been able to store all the character pattern recognition training data into the file that the user wants. For this reason, the author tries to save the results of the "A" and "C" letter pattern recognition training that has been carried out into a file with the name of the test.

![Figure 16: Storage Testing of Letter Pattern Training Results](image)

After pressing the Save button, the display that appears on the screen is the process of saving the results of the character pattern training.
The storage of the training results has been successful, the process of opening this database is carried out by pressing the Open button on the Main form and selecting the file name testing.ptr. The results obtained are the emergence of information on the number of databases stored in the database.

### Table 1: Comparison Results of Column Similarity

| Column To | Similarity Percentage |
|-----------|-----------------------|
| 1         | 100                   |
| 2         | 100                   |
| 3         | 100                   |
| 4         | 100                   |
| 5         | 93.3333               |
| 6         | 63.3333               |
| 7         | 56.6667               |
| 8         | 50                    |
| 9         | 43.3333               |
| 10        | 56.6667               |
| 11        | 56.6667               |
| 12        | 53.3333               |
| 13        | 53.3333               |
| 14        | 43.3333               |
| 15        | 43.3333               |
| 16        | 53.3333               |
| 17        | 60                    |
| 18        | 60                    |
| 19        | 50                    |
| 20        | 50                    |
| 21        | 46.6667               |
| 22        | 50                    |
| 23        | 66.6667               |
| 24        | 76.6667               |
| 25        | 90                    |
| 26        | 100                   |
| 27        | 100                   |
| 28        | 100                   |
| 29        | 100                   |
| 30        | 100                   |
Pattern recognition by applying artificial neural network techniques is very appropriate for use in pattern matching. Pattern recognition which aims to generate and select patterns that can be used at the time of identification, image pattern recognition will be mapped into grids, where each black grid is assigned a value of 0 and a white grid is assigned a color of 1. The percentage of similarity of image pattern recognition with a 100% similarity level.

CONCLUSION

Based on the results of the implementation of the character pattern recognition software design with this perceptron method. Perceptron method, a software can be generated to recognize character patterns based on the pixel values of the characters entered by the user. The Perceptron method requires training in recognizing a character pattern. The results of this pattern recognition training will later be used as reference material in recognizing the input character patterns. The Perceptron method recognizes the inputted letter pattern by comparing the pixel weight of the inputted character with the weight of the character pattern stored in the database. With a 100% similarity level, the proportion of similarity of visual pattern recognition.

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