

Recognition of Hijaiyah Letter Patterns Using the Bidirectional Associative Memory Method

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ABSTRACT

Artificial Intelligence has a very broad scope so it can solve very complex problems. Hijaiyah letter pattern recognition using the Bidirectional Associative Memory (BAM) method has the ability to detect maximum results for the blind who are learning to recognize hijaiyah letters in producing information using a bipolar system. The problem in this research is the difficulty for blind people in recognizing hijaiyah letters and patterns, so this research was designed to help blind people learn hijaiyah letters so that they can easily understand the patterns and types of letters using the 3x3 order matrix concept. In the BAM has the advantage of layers that are interconnected between one layer and another layer so that they can be connected from the input layer to the output layer. This research will produce a Hijaiyah letter recognition pattern using the 3x3 Matrix system to design a system for identifying Hijaiyah letter patterns. From the results of the tests that have been carried out, there are 5 Hijaiyah letter patterns, namely ا, ث, ذ, ج, and ش which are processed by pattern recognition with a value of 1. [1,1] [1,-13],[-1,1][3,-11],[1,-1] [-9,-17], [-1,1][[13,9], [-1,1][-13,13]. Of the 5 Hijaiyah letter patterns, only 2 letter patterns were able to be recognized by the system, namely the letters ذ and ش, and 3 patterns were not able to be recognized by the system. Thus it can be concluded that not all patterns using the BAM method are able to recognize patterns precisely and correctly.

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1. INTRODUCTION

The Hijaiyah letters are the Arabic alphabet starting from ا (alif) to the letter ي (ya). Hijaiyah letters are the same as the letters of the Indonesian alphabet which are composed of the letters A to Z which can be arranged into sentences or other Arabic languages. The hijaiyah letters total 30 letters if you add hamzah (ء) and lam alif (آ). For Muslims, understanding how to read the Koran properly and correctly is closely related to understanding the hijaiyah letters. The root of the word hijaiyah letters comes from Arabic, namely from the word harf (letter) and the word hijaiyah comes from the verb hajja which means to spell, count letters and read letter by letter. The research that will be studied is the introduction of hijaiyah letters for blind people. This research can help blind people learn hijaiyah letters by feeling the pattern and matrix system, making it easier to understand the letters. The work process of this research uses a 3x3 Matrix order system. This way of recognizing letters uses a 3x3 city. The advantages of this research have never been researched, so the author is interested in conducting research using ANN.

Technological developments are increasing as seen from the many technologies currently being developed, especially technologies related to artificial neural networks. According to [1] artificial neural

networks are thought to be like the human brain because they are able to think like humans. According to the paradigm presentation, the information processing system consists of a number of large elements that are interconnected between neurons that work together to solve problems [2]. The term artificial neural network can be implemented using a computer program system that is able to solve all problems related to calculations in the learning process. Research Objective: The use of Hijaiyah Letter Patterns can help the system detect the authenticity of the patterns used, besides that it can be used as a reference for the visually impaired and those learning Hijaiyah letters, both children and adults, in reading and understanding letter patterns by looking at the position of the boxes and lines used. In data processing, there are 30 Hijaiyah letters with varying matrix sizes, so the data is grouped selectively so that the grouped data can obtain accurate values as expected in the final results of this research.

Below are journals that are used as references, including:

Research conducted by Leni Husna and Sestri in (2023) [3] aims to address the problem of this research, namely the lack of public understanding regarding the threat of punishment for forging signatures, and the lack of accuracy in checking original signatures according to the owner of the original signature. This research presents an analysis of the legal consequences of the crime of signature forgery and an analysis of the use of artificial intelligence to prove the authenticity of a signature using the 3X3 Order Matrix system, with this pattern we can see whether the signature used is genuine or fake [3]. Journal 4 Research discovered by Sestri (2023) [4] with the goal achieved, namely that pattern recognition can be completed using a complex system to produce information that can be used as a system to determine the confidentiality of data. The Heteroassociative memory method is able to read secret codes based on binary input values that have been processed. According to the journal Silvilawan (2023) [5] The Hebb Rule method finds a way to calculate the weight value w and bias value which can be processed easily without carrying out a training process first. The Hebb Rule algorithm is the oldest method with a work process using learning and supervision methods. The aim of this research is to obtain pattern results in accordance with predetermined targets. Based on his input patterns consisting of pattern 1, pattern 2, pattern 3 and pattern 4, all patterns can be read by the system.

According to the journal Yendrizar (2023) [6] The aim of this research is pattern recognition on smartphones according to the user's secret key to avoid data theft and other criminal acts. Pattern recognition using BAM Continuous Associative Memory Bidirection Method using Activation and sigmoid functions. Smartphone pattern recognition consists of 5 patterns, namely Z pattern, O pattern, M pattern, O pattern and W pattern. The pattern results obtained from $Z=[7,7]$, $O=[11,15]$ pattern, $M=[$ pattern 13,7], pattern $X=[7,9]$, pattern $O=[11,15]$. Based on the final results after searching for 5 patterns, only pattern $Z=[7.7]$ and pattern $X=[7.9]$ which are the same as the expected target in pattern recognition are included.. According to Rozi Meri's research in 2023 [7], the main aim of this research is to help users diagnose the symptoms of skin diseases so that they can get quick health treatment. This Hebb rule research has not yet been used to diagnose skin diseases. The method used in this research is the Hebb rule method, which is a method that works similar to the way the human brain works. This method will improve the value of the weights connected to each other and both at the same time so that the weights of both are increased. The new weight will be obtained from the addition of the old weights with the same input and output unit activities. In the process of resolving skin disease cases, there are 4 input variables, namely tinea versicolor, athlete's foot, ringworm and scabies, each variable has different symptom characteristics with a total of 16 symptoms.. According to the Padma Mike journal in 2022 [8] The aim of this research is to determine the effectiveness of the Continuous BAM Method in recognizing Kabataku character patterns in calculation operations in Mathematics. The Bidirectional Associative Memory (BAM) method has the capability that associative memory or content addressable memory can be called up by using parts stored in the memory itself. BAM in artificial neural networks has 2 layers, namely the input layer and the output layer which are interconnected between the two, also known as bidirectional, with the working process if the weight matrix of the signal sent from the input layer X to the output layer Y is W , then the weight matrix of the signal sent from output layer Y to input layer X is WT . The Continuous BAM method will change input to output more smoothly with values that lie in the range $[0,1]$. The activation function used is the sigmoid function. The final result of pattern recognition is $x_1 = [-8 -12]$, $x_2 = [8 0]$, $x_3 [12 8]$, $x_4 = [16 12]$ Not all patterns match the target.

According to the journal Alvendo and Sestri [9] The aim of this research is to help mechanics who find it difficult to detect damage to machines due to the absence of a good computerized system. The use of Shielded Metal Arc Welding (SMAW) in the industrial world is quite widely used. With this machine it is very human helped by the need to make a metal object. So with frequent use of this tool it will the more susceptible they are to damage to the equipment. The machinists supplied by the company are not in proportion to the number machine. Therefore, to help solve this problem. The aim of this research is to make mechanics easier in detecting machine damage. According to Rayendra's journal in 2023 [10] it is explained that the weight will be changed to a smoother value provided that the result is between $[1,0]$.

The function used in this research is the sigmoid activation function. The results of letter pattern recognition from this research use a 5x5 order matrix system with input of 3 characters, namely the letters S, O and the letter] produces the pattern [27 -3] does not match the target and the letter X [-1,1] produces the pattern [-37 21] matches the target. Thus, not all patterns can achieve the specified target. According to the journal Aperijs Giawa in 2019 [11] explains that this facial attendance system is very dependent on the intensity of light in the photo. If the light intensity in the photo in the training process is almost the same as the photo in the testing process, then the photo will be recognized. However, if the difference in light intensity is very significant, the photo cannot be recognized.. According to the journal Very Karnadi and Andrinaldi in 2022 [12] The main aim of this research is to help users diagnose the symptoms of skin diseases so that they can get quick health treatment. This Hebb rule research has not yet been used to diagnose skin diseases. The method used in this research is the Hebb rule method, which is a method that works similar to the way the human brain works. This method will improve the value of the weights connected to each other and both at the same time so that the weights of both are increased. The new weight will be obtained from the addition of the old weights with the same input and output unit activities. In the process of resolving skin disease cases, there are 4 input variables, namely tinea versicolor, athlete's foot, ringworm and scabies, each variable has different symptom characteristics.

2. RESEARCH METHOD

Artificial neural network, abbreviated as ANN, is an information processing technique that works like a biological nerve cell system, producing mathematical models to solve problems. According to another opinion, ANN is a computing system where the architecture and operation are inspired by knowledge about biological nerve cells in the brain [13]. Artificial neural networks are able to capture complete input and output relationships so that they are able to solve problems easily and solve complex systems [14]. The approach of artificial neural networks in pattern recognition is based on the learning method used to obtain output from the network. In the Supervised learning approach, the desired response to be recognized by the system is the system that was previously trained to get the desired output [15].

The artificial neural network approach to pattern recognition is based on the learning method used to obtain output from the network. In the Supervised learning approach, the desired response to be recognized by the system is the system that was previously trained to get the desired output [16]. Several studies using artificial neural networks include: Pattern Recognition in Online and Offline Signature Images using Artificial Neural Networks using the Backpropagation Method [17]. Transliteration of Hiragana Script Image Using Backpropagation Network [18]. Implementation of Artificial Neural Networks for Recognition of Beam Notation Patterns Using the Backpropagation Method [19]. Analysis of Artificial Neural Networks for Hiragana Letter Pattern Recognition with the Perceptron Network Model [20]. To obtain good research results, a systematic research method is needed from start to finish. The steps for this research include:

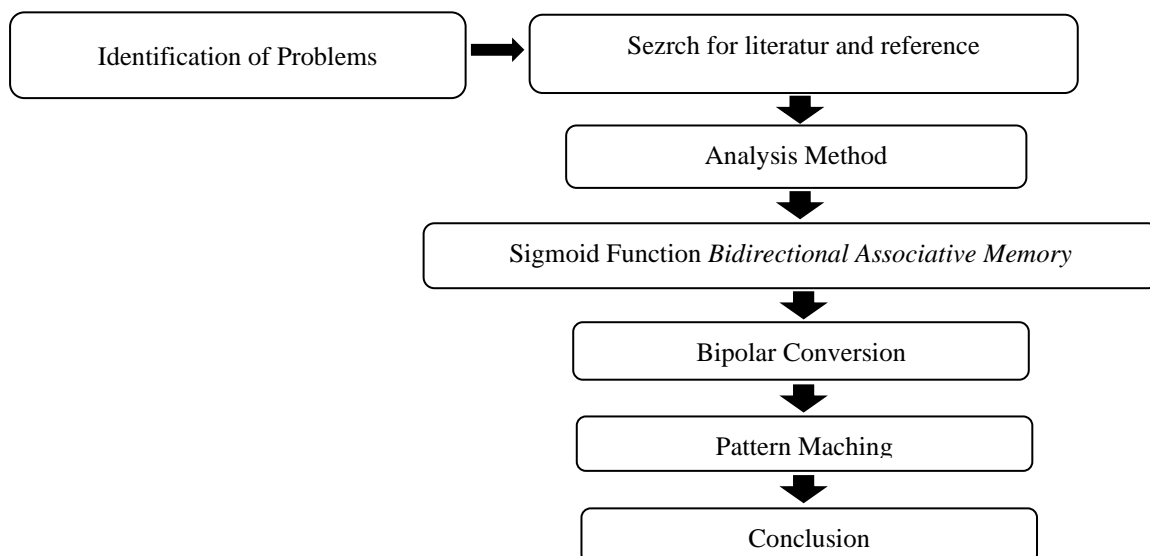


Figure 1. Research Methodology

The explanation of figure 1 can be seen as follows:

1. The detailed steps for this research are: Identify the Problem

2. Formulate the problem from the background of the problems that occur in recognizing hijaiyah letter patterns. Search for literature and references Study reference books and journals related to the research carried out.
3. Bidirectional Associative Memory Analysis Method
the ability to detect results from memory that can be used to produce information using a bipolar system
4. Sigmoid Function
Makes the calculation process using the Binary system 0 and 1
5. Bipolar Conversion
The value calculation process is in accordance with predetermined targets.
6. Pattern Matching
After determining the target, the next step is to match the basic pattern with the target or final result in the form of an output value.
7. The final result of the output value

2.1. Artificial Neural Networks

Artificial Neural Networks have the ability to retain knowledge obtained from the results of training. This ability similar to the function of the human brain, so Artificial Neural Network systems can be used on jobs that require human intelligence. In carrying out the process learning, Artificial Neural Networks can modify his behavior accordingly environmental conditions. Artificial Neural Networks can organize himself to produce a consistent response to a series of inputs. A number of Artificial Neural Networks have capabilities to abstract the essence of a series input. Neural network applications during these past few years have generally centered on three main areas, namely data analysis, introduction patterns, and control functions. Artificial Neural Networks have excellent abilities in pattern recognition techniques.

Artificial Intelligence (AI) is a part of computer science that enables machines (computers) to do work like and as well as humans do [15]. Artificial neural networks are an appropriate computational technique because this computational technique was developed based on the workings of the human biological nervous system so that it has the ability to learn and recognize things, even if there are ANN deviations (noise) [17]. Artificial Neural Networks were created as a generalization of the mathematical model of human understanding (human cognition) which is based on the following assumptions:

1. Information processing occurs in simple elements called neurons.
2. Signals flow between nerve cells / neurons through a connecting connection.
3. Each connecting joint has a corresponding weight. This weight will be used to double/multiply the signal sent through it.
4. Each nerve cell will apply an activation function to the weighted sum signal that enters it to determine its output signal [19].

2.2 Bidirectional Associative Memory (Bam) Method

Artificial Neural Network is a characteristic information processing system its performance resembles a biological neural network. Artificial Neural Networks have developed as Mathematical model of the human mind viz biological nerves, which are based on assumptions as follows [19].

1. Information processing occurs on many simple elements are called neurons.
2. The signal is passed through the connection between neurons.
3. Each connection has a weight, which amplifies the signal through it.
4. Each neuron implements a function activation to the input layer (number of signals weighted input) to determine the signal output.

BAM is a form of heteroassociative memory network, which was developed by Kosko (1988). BAM stores training patterns in an $n \times m$ matrix which is the product of the input vector and the training target (outer product). The BAM architecture consists of 2 layers connected by a weight connection path. The network will iterate, sending signals back and forth between the two layers until all neurons become stable (all neuron activations are constant). BAM can respond to input from both layers. Weight is bidirectional (Tjung et al. 2013). There are 2 types of artificial neural Bidirectional Associative Memory (BAM), namely:

1. Discrete Bidirectional Associative Memory In discrete Bidirectional Associative Memory (BAM), there are 2 types of input, namely binary and bipolar.
2. Continuous Bidirectional Associative Memory Continuous BAM will transform input more smoothly and continuously into output areas with values in the range [0,1] [20].
3. The second activation function is a bipolar sigmoid which has a value range of [-1,1] and is defined as:

$$f(x) = \frac{2}{1 + \exp(-\sigma x)} - 1 \tag{1}$$

$$f(x) = \frac{\sigma}{2} [1 + f(x)][1 - f(x)] \tag{2}$$

$$w_{ij} = \sum_p (2 * s_i(p) - 1)(2 * t_i(p) - 1) \tag{3}$$

$$y_j = \begin{cases} 1; & jikay_in_j > 0 \\ y_j; & jikay_in_j = 0 \\ 0; & jikay_in_j < 0 \end{cases} \tag{4}$$

$$x_i = \begin{cases} 1; & jikax_in_i > 0 \\ x_i; & jikax_in_i = 0 \\ 0; & jikax_in_i < 0 \end{cases} \tag{5}$$

$$w_{ij} = \sum_p (s_i(p) * t_i(p)) \tag{6}$$

3. RESULTS AND ANALYSIS

The Bidirectional Associative Memory method consists of 2 parts, namely the input layer and the output layer which have a reciprocal relationship between the two. The form of the relationship is bidirectional, meaning that if the weight matrix of the signal to be sent from input layer X to output Y is W, then the final form of the signal sent from input layer X to output layer Y will be WT. Continuous BAM is able to change the input into a smaller or smoother output with a value range between [0,1]. The BAM method process used in this research is changing the hijaiyah letter pattern into a smaller form using the value [0,1]. The process is creating a table consisting of the order 3x3, if the 3x3 table is about a line it is calculated with a value of 1 and if not regarding the line is calculated with a value of -1. After the conversion process is carried out, the next step is to save the weight matrix and the final step is to test whether the resulting pattern is the same as the target, if it is the same then the pattern can be recognized by the system and if it is different then the pattern is not recognized by the system or can be called an error pattern. Architecture The pattern designed in this research can be seen in the architecture figure 2.

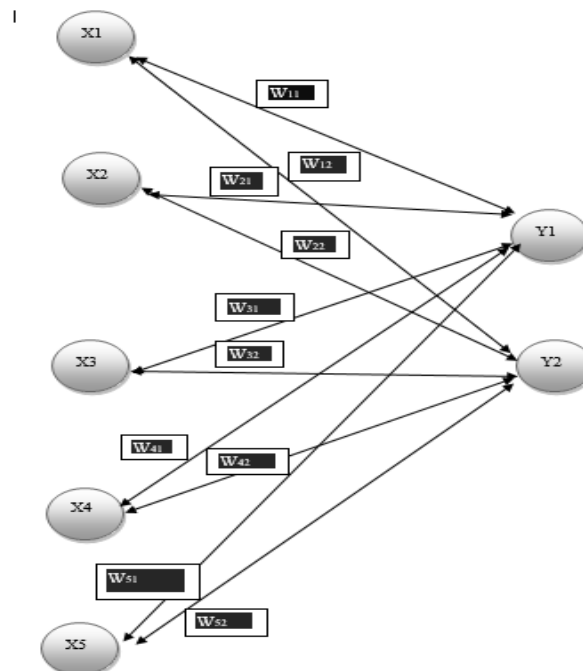
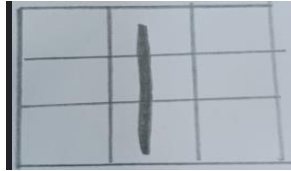


Figure 2. Continuous BAM architecture

To get the Hijaiyah Letter Pattern, the completion process is by converting the image into binary form. For each value, the target value that must be produced is known. The results of the discussion can be seen from the mapping of each Hijaiyah letter sign pattern presented using a bipolar code.

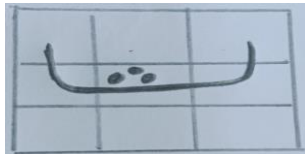
1. Pattern Maching ا



Bipolar Conversion Result

-1	1	-1
-1	1	-1
-1	1	-1

2. Pattern Maching ث



Bipolar Conversion Result

1	-1	1
1	1	1
-1	-1	-1

The next step is to make a conversion for each pattern value

1. Introduction to the Hijaiyah Pattern "ا" is stored in = [1,1]

The form of the conversion process is multiplied by the value of the sign weight pattern used for each hijaiyah letter with the results of each sign pattern value being saved.

$$W_{(Tanda \#)} = \begin{bmatrix} -1 \\ 1 \\ -1 \\ -1 \\ 1 \\ -1 \\ -1 \\ 1 \\ -1 \end{bmatrix} [1, 1] \begin{bmatrix} -1 & -1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ -1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \end{bmatrix}$$

2. Introduction to the Hijaiyah Pattern "ث" stored in = [1,-1]

The form of the conversion process is multiplied by the value of the sign weight pattern used for each hijaiyah letter with the results of each sign pattern value being saved.

$$W_{(Tanda \#)} = \begin{bmatrix} 1 \\ -1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \\ -1 \\ -1 \end{bmatrix} [1, -1] \begin{bmatrix} 1 & -1 \\ -1 & 1 \\ 1 & -1 \\ 1 & -1 \\ 1 & -1 \\ 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \end{bmatrix}$$

3. Hijaiyah Pattern Recognition "ج" is stored in = [-1,1]

The form of the conversion process is multiplied by the value of the sign weight pattern used for each hijaiyah letter with the results of each sign pattern value being saved.

$$W_{(Tanda /)} = \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \\ 1 \\ 1 \\ 1 \\ -1 \end{pmatrix} [-1, 1] \begin{pmatrix} -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \end{pmatrix}$$

4. Hijahiyah Pattern Recognition “ذ” is stored in = [1,1]
 The form of the conversion process is multiplied by the value of the sign weight pattern used for each hijahiyah letter with the results of each sign pattern value being saved.

$$W_{(Tanda /)} = \begin{pmatrix} 1 \\ 1 \\ -1 \\ -1 \\ 1 \\ -1 \\ -1 \\ 1 \\ -1 \end{pmatrix} [-1, 1] \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \end{pmatrix}$$

5. Hijahiyah Pattern Recognition “ش” is stored in = [-1,1]
 The form of the conversion process is multiplied by the value of the sign weight pattern used for each hijahiyah letter with the results of each sign pattern value being saved.

$$= \begin{pmatrix} -1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ -1 \end{pmatrix} [-1, 1] \begin{pmatrix} 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \end{pmatrix}$$

$$\begin{pmatrix} -1 & -1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ -1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \end{pmatrix} + \begin{pmatrix} 1 & -1 \\ -1 & 1 \\ 1 & -1 \\ 1 & -1 \\ 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \end{pmatrix} + \begin{pmatrix} -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \end{pmatrix} + \begin{pmatrix} 1 & 1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \\ -1 & -1 \\ 1 & 1 \\ -1 & -1 \end{pmatrix} + \begin{pmatrix} 1 & -1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ -1 & 1 \\ 1 & -1 \end{pmatrix}$$

The overall calculation process for each pattern:

Process 1

In process table 1, it is obtained from data processing for each pattern recognition. All patterns are entered into a table so that each pattern value is visible. In the results table it can be seen that the sum of each value x1, x2, x3, x4 and x5 is different. The results table is obtained from the sum of all variables x.

Table 1. Process 1

X1	X2	X3	X4	X5	Value
-1	1	-1	1	1	1
1	-1	-1	1	-1	-1
-1	1	-1	-1	-1	-3

X1	X2	X3	X4	X5	Value
-1	1	-1	-1	-1	-3
1	1	-1	1	-1	1
-1	1	1	-1	-1	-1
-1	-1	-1	-1	-1	-5
1	-1	-1	1	-1	-1
-1	-1	1	-1	1	-1

Process 2

In process table 2, it is obtained from data processing for each pattern recognition. All patterns are entered into a table so that each pattern value is visible. In the results table it can be seen that the sum of each value x1, x2, x3, x4 and x5 is different. The results table is obtained from the sum of all variables x.

Table2. Process 2

X1	X2	X3	X4	X5	Value
-1	-1	1	1	-1	-1
1	1	1	1	1	5
-1	-1	1	-1	1	-1
-1	-1	1	-1	1	-1
1	-1	1	1	1	3
-1	-1	-1	-1	1	-3
-1	1	1	-1	1	1
1	1	1	1	1	5
-1	1	-1	-1	-1	-3

Final Result of Pattern Match Calculation:

$$\begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix}$$

The search step is to obtain the output value, namely the weight matrix W to connect the input layer neurons to the output layer. Input to Output Layer Weight Matrix Process The value of the weight matrix W connects neurons from the input layer to the output layer.

$$1. Y_{in1=X1*W} = [-1 \ 1 \ -1 \ -1 \ 1 \ -1 \ -1 \ 1 \ -1] = \begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix} = [1, -13]$$

$$2. Y_{in1=X1*W} = [1 \ -1 \ 1 \ 1 \ 1 \ 1 \ -1 \ -1 \ -1] = \begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix} = [3, -11]$$

$$3. \quad Y_{in1=X1*W} = [1 \ 1 \ 1 \ 1 \ 1 \ -1 \ 1 \ 1 \ -1] = \begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix} = [-9, -17]$$

$$4. \quad Y_{in1=X1*W} = [1 \ 1 \ -1 \ -1 \ 1 \ 1 \ -1 \ -1 \ 1 \ -1] = \begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix} = [13,9]$$

$$5. \quad Y_{in1=X1*W} = [-1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ 1 \ -1] = \begin{pmatrix} 1 & -1 \\ -1 & 5 \\ -3 & -1 \\ -3 & -1 \\ 1 & 3 \\ -1 & -3 \\ -5 & 1 \\ -1 & 5 \\ -1 & -3 \end{pmatrix} = [-13,13]$$

The test results after carrying out the calculation process using Continuous BAM ANN show 5 Hijaiyah letter patterns, namely ذ, ج, ث, ا, and ش which process pattern recognition with a value of 1. [1,1] [1,-13],[-1,1][3,-11],[1,-1] [-9,-17],[-1,1][[13,9], [-1,1][-13,13]. Of the 5 Hijaiyah letter patterns, only 2 letter patterns can be recognized by the system, namely the letters ذ and ش, and 3 patterns that the system cannot recognize. The final results can be seen in the table 3.

Table 3. The final result

No	Pattern	Target	Results	Information
1	ا	[1,1]	[1,-13],[-1,1]	error
2	ث	[1,-1]	[-1,1][3,-11]	error
3	ج	[-1,1]	[1,-1] [-9,-17]	error
4	ذ	[-1,1]	[13,9], [-1,1]	Accurate
5	ش	[-1,1]	[-1,1][-13,13]	Accurate

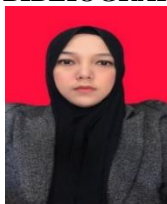
Test results for each ANN do not all produce patterns recognized by the system, the pattern results depend on the input pattern. To get better results in testing, it is best to use additional systems such as digital images.

4. CONCLUSION

Bidirectional Associative Memory (Bam) can help the blind in recognizing hijaiyah letter patterns using predetermined patterns. The pattern used is a pattern of lines that pass through a matrix box so that it can be illustrated if the pattern of connected lines can produce a hijaiyah letter. Hijaiyah letters consist of 30 letters, each letter has a different pattern and shape so special understanding is needed for the blind in understanding the pattern. each letter so that it is easy to remember and understand. Lack of BiDirectional Associative Memory method (BAM is not able to recognize hijaiyah letter patterns 100%. Development prospects for this research should use a combination of Continuous BAM Neural Networks and Discrete Artificial Neural Networks to obtain more accurate results. To obtain more accurate and good research results It is best to combine using digital image software and application programs.

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