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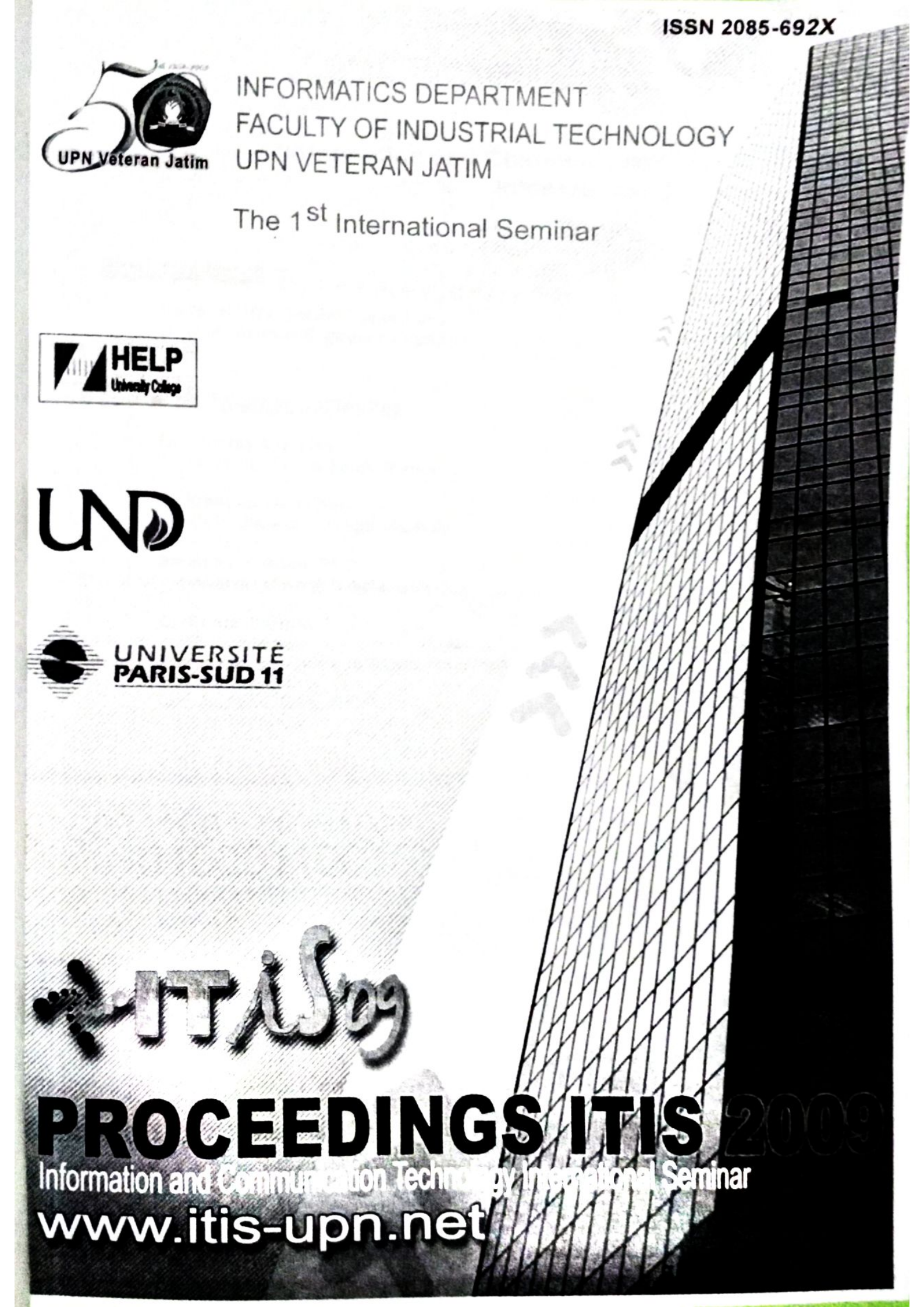

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Table of Content

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A COUNTER-PROPAGATION ARTIFICIAL NEURAL NETWORK TO INTRODUCTION OF TWO DIMENSION IMAGE

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ABSTRACT

In this case the writer makes an application in two dimension image introduction. The method is focused on the way to data extraction from available samples. The data extraction steps are dividing samples into some research areas. Then from each region is taken active pixel value so that it can be obtained numeric data as much as available areas. The numeric resulted data is then normalized by fixed compares, where each numeric data is from same data. To prove the methods, the writer makes a supporting application that is char-cognition by basic visual programming language. The final result from the analysis shows that the resulted pattern by the method can be well recognized.

Keywords: Neural Network, artificial neural network counter propagation, char-recognition.

1. INTRODUCTION

1.1. Background

In generally, the important aspect that underlying several theory in Artificial Intelligent. Is design recognition system. Design recognition concept can be implementated in several sector, such as medical sector, military sector, education, etc. the principal problem in design recognition implementation is how the data acquisition executed so that production amount of numerical data which is representated and consistenly about the giving sample.In this research,writer make counter propagation neural network application for acquainted in two dimension image shape's design with the result that can be identified by design recognize design method. The media for save data using Microsoft Visual Basic 6.0 and Microsoft Access.

1.2 Problem Formula

Building on introduction, problem is formulated by method of how to make design recognize for two dimension image application which is an implementation from design recognize concept.

1.3 Problem Limit

This problem will limited by:

1. Image which can be processed is drawing image with tool which prepared from the application.
2. Criticize the extraction data method from a digital image becomes series of numeric data.

1.4 Direction

Make counter propagation neural network application for acquainted in two dimension image shape's design with the result that can be identified by design recognize design method.

1.5 Divining annual research

Extraction data method for recognize character and number hand note using counter propagation neural network application was related in a certain way by Nugraha and Mutiara. The different with this research is the conversion image aimed as the input of counter propagation neural network and extraction data method especially for two dimension image shape.

2. LITERATURE REVIEW

2.1 Image Processing Substance

Generally, image is defined as a visual representation of an object. In computer field, the image is a visual representation from an object after experiencing several data transformation from several series of numeric.

2.2 Counter Propagation Neural Network

Counter-propagation is one of artificial neural network learning process where in the process changing value is backward that is from output layer and finally input layer. The algorithm is as follows:

1. Neuron output value calculation at hidden layer and output.

$$net_i = \sum_{i=1}^{n} \left(w_{ij} s_j \right) + q_i$$

$$s_i = f\left(net_i \right)$$

where,

i : neuron number that is being calculated its activation signal
j : neuron number that the output is contributed to i neuron
s_j : output value j neuron
w_{ij}: relation content value between to i and j
q_i : neuron bias value to I net function or f (neti) is also called as activation function that the form can be vary.

2. Mistake calculation in learning process is called energy function.

$$E = \sum_{(x,y)} \sum_{i} \left(y_i^x - s_i^s \right)^2$$

where,
y_i: si I output neuron target output
x: actual output neuron output I when the network connected to x sample

3. Neuron (δi) sensitivity calculation in the hidden layers and output where the equation used to sensitivity calculation both for hidden layers or output layers depends on activation function used.
4. Weigh and bias change value calculation.
Weight change:

$$\Delta W_{ij}(x,y)\delta_i s_j^x$$

Bias change:

$$\Delta q_i(x,y)\delta_i$$

5. New weight and bias calculation
New weight:

$$w_{ij}^{t+1} = w_{ij}^t + \Delta w_{ij} + momentum\,\Delta w_{ij}^{t-1}$$

New bias:

$$q_i^{t+1} = q_i^j + \Delta q_i^1$$

6. The steps are repeated until small output deviation so that reaches expected stopping criteria error.

This writing is used is an important parameter sigmoid activation function other from JSB is how output from JSB is represented distributive.

3. DISCUSSION AND IMPLEMENTATION

3.1 Case Analysis

An image that will be identified called sample must through certain steps so that can be a good input. The inputs that can be well accepted are numeric data. Therefore the case is how to converse a digital image becomes series of numeric data that representative and consistent.

3.2 Data Acquisition Method

Each data sample that will be researched and analyzed must be well represented numeric data. Therefore needs a method that can extract characteristic data from each sample consistently.

A. Data Extraction

To obtain accurate and consistent data from the sample, is used a simple method by counting active pixel numbers that available in sample parts. Numeric data extraction algorithm from each sample is:

1. Each researched sample is divided into several areas such as four columns and five rows so that will become 20 research regions.
2. Active pixel numbers (which is not white, but black) in each region is calculated accurately.
3. Obtained some 20 numeric data with column and rows attribute that is expected to represent characteristic from expected samples

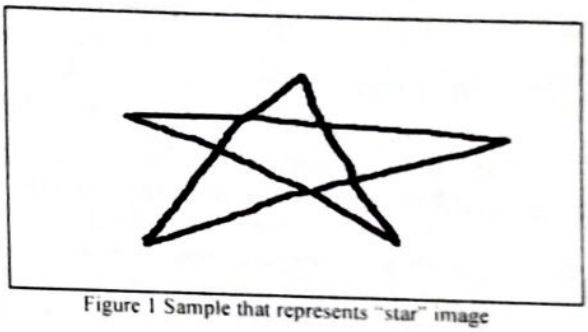

Figure 1 Sample that represents "star" image

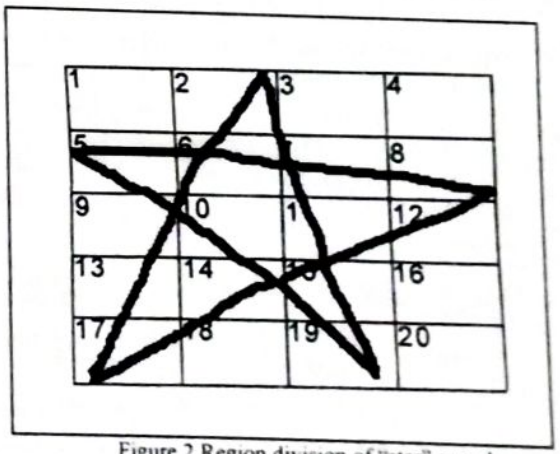

Figure 2 Region division of "star" sample

Figure 2 shows region division on "star" image. Then after the picture is divided into some regions, next steps are calculating active pixels from each region. The result from active pixels calculation each region will be expressed in Table 1.

Table 1 Active pixel grade each region in "star" sample

Region	Active Pixel Grade
1	0

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2	82
3	1
4	0
5	74
6	108
7	71
8	57
9	50
10	53
11	74
12	62
13	43
14	86
15	101
16	0
17	109
18	17
19	81
20	0

B. Data normalization

To maintain data consistence in each research sample, each numeric data must be through a normalization process. Normalization method that will be used itself is a very simple method that is fixed compared normalization. In this case is a compare between active pixel numbers in each region with the most active pixel. The result form normalization process is a series of fraction rated among 0 (zero) to 1 (one). In Table 1 shows that the highest pixel numbers lie in region 17 that is 109. Therefore active pixel numbers from each region will be divided into 109 so that will result in numeric data as shown in Table 2.

Table 2 Normalized numeric data each region in "star" sample

Region	Active Pixel Grade	
	Original	Normalized
1	0	0
2	82	0.7523
3	1	0.0092
4	0	0
5	74	0.6789
6	108	0.9908
7	71	0.6514
8	57	0.5229
9	50	0.4587
10	53	0.4862
11	74	0.6789
12	62	0.5688
13	43	0.3945
14	86	0.789
15	101	0.9266
16	0	0
17	109	1
18	17	0.156
19	81	0.7431
20	0	0

3.3 Numeric Data Accumulation

Each numeric data, each sample is normalized so that the data collection will be accumulated in the spray form so that it is implemented in JSB. The accumulated final data must cover all input parameter needed by JSB from each parameter sample. The data that must be output target from each sample and also numeric data collection from each area in each sample.

3.4 Artificial Neural Network Structure

JSB is only used as a tool to analyze and also to prove extraction concept that is made. JSB Structure is collection of in order neurons so that forms a meaningful structure. JSB structure as be seen. The following is neuron quantity rule in each layer can be seen in the following table:

Table 3 Neuron Distribution

Layer	Neuron quantity
Input	depends on region quantity
Hidden	10
Output	8

JSB has some algorithm that can be implemented. Here is used counter propagation algorithm. Activation function used is sigmoid activation other than structure, algorithm, activation function, initial value parameter, Learn rate, Momentum, Stopping criteria error, Hard Trapping, Match level will affect final result of JSB.

4. ANALYSIS AND SIMULATION

4.1 Sample Preparation

The sample making needs to pay attention carefully to obtain consistent data towards target value. The form of the samples must be consistent and uniform. Sample quantity will also affect JSB performance.

4.2 Learning Activity Simulation

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The first experiment done is value affect analysis of Learn Rate, Momentum, and finally is initial value reach affect. For the two first experiments used initial value reach of 02 to 2. The experiment that will be done will be given several limitations so that can be obtained an effective result. The limitations are as follows:

1. Sample used is sample 1 with Region = 5*4;
2. Maximum epoch quantity is 1000
3. Learning process is stopped if it is gained one of two criteria that is Hard trapping, Match Level or Stopping Criteria Error;
4. For each case is done several experiments and taken the best one to be temporary manual to the next learning process.
5. The best result of experiment from the biggest grade of Hard Trapping, Match Level and or the smallest Stopping Criteria Error value;
6. The objective is to obtain the best JSB characteristic so that the JSB can 'learn' pattern given the best.

A. Learn rate Affect

To do Learn rate affect to JSB, firstly must be decided Momentum = 0, in order to the experiment will not be affected by the Momentum value. The experiment is done in critical and very extreme of 0.1; 0.3; 0.5; 0.9.

Table 4 Learn Rates affect experiment result

Experiment	Learn Rate	Epoch	Error Level	Match Level
Simulation 1	0.1	1000	20.12467	35%
Simulation 2	0.3	1000	36.32532	48%
Simulation 3	0.5	1000	31.32511	45%
Simulation 4	0.9	1000	82.61123	30%
Simulation 5	1	1000	136.22421	0%

From the five of the simulation can be concluded that the best Learn Rates by the lowest Error Level is 0.1 and the best Learn Rates based on the highest Match Level is 0.3. Otherwise, due to successful rate from this experiment is not measured by low rate of Error Level but from the high of Match Level rate, so that Simulation 2 with Learn Rates=0.3 that will be used in the next experiment.

B. Momentum Effect

The following experiment will use the best Learn Rate value that is obtained from previous experiment and uses different Momentum grade (0.1; 0.2; 0.5; 0.7; 0.91) to analyze the best result based on the Momentum grade. Another parameter such as initial reach is still same with the previous experiment. The following is some simulation done to Momentum grade change.

From the simulation, it can be obtained conclusion that JSB has a better learning trend in choosing symmetrical reach and, in contrary, is not symmetrical. From Simulation 7 and Simulation 8 seems that the smaller magnitude (-2 to +2), JSB also has trend 6 to learn better. Therefore in the next experiment will be used the grade reach.

Table 5 Momentum Affect Experiment Result

Experiment	Momen-tum	Epoch	Error Level	Match Level
Simulation 1	0.1	1000	27.32457	83%
Simulation 2	0.2	1000	49.23567	51%
Simulation 3	0.5	1000	15.72831	100%
Simulation 4	0.7	1000	35.47721	62%
Simulation 5	0.9	1000	29.48925	69%
Simulation 6	1	1000	52.31267	56%

From the above simulations can be concluded that the best Momentum rate is obtained in Simulation 3 with Momentum grade = 0.5. In Simulation 3 obtained Mark Level successful grade = 100% in epoch 230 that shows JSB can learn better in the condition. Therefore, Learn Rate grade combination and Momentum is temporarily can be manual to the next analysis.

C. Initial value Reach Affect

The following is an experiment to analyze initial value reach affect to JSB. In this experiment will be used JSB with the best characteristic obtained from the previous experiment that is Learn rates=0.3 and Momentum grade = 0.5. The following is some simulations towards initial value reach difference.

Table 6 Reach Affect Experiment Result

Experiment	Reach	Epoch	Error Level	Match Level
Sim 1 (A)	0 s/d +2	1000		0%

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Sim 2 (A)	0 s/d - 5	1000		0%
Sim 3 (A)	-5 s/d 0	1000		78%
Sim 4 (A)	-2 s/d 0	1000		45%
Sim 5 (A)	-5 s/d 2	1000		62%
Sim 6 (A)	-2 s/d -5	1000		22%
Sim 7 (A)	-2 s/d -2	230		100%
Sim 8 (A)	-3 s/d -5	100		92%

D. Region Composition Affects towards JSB Sample

From all of the experiments obtained a good JSB characteristic with Learn rates value parameter = 0.3; Momentum = 0.5, and initial value reach= -2 to +2. The experiment has proved that letter pattern introduction method and hand writing numbers made by the writer can be 'learned' well by JSB. This is recognized by the reach of Match Level value =100% with the characteristic meant. Otherwise to complete experiment and analysis to the methods, the writer carries out an experiment that is Region composition affect towards JSB characteristic and final result that will be obtained. The result of several simulations done can be seen in Table 6. From the six simulations can be seen that Simulation 1 gives the best learning result. Therefore, it can be concluded that temporary Region 5*4 composition is the best.

Table 7 Region composition affect experiment result

Experiment	Region	Epoch	Error Level	Match Level
Simulation 1	5*4	230	15.72831	100%
Simulation 2	4*5	1000	42.67325	62%
Simulation 3	4*4	1000	40.87121	48%
Simulation 4	4*3	1000	38.67128	55%
Simulation 5	3*4	1000	28.97213	80%
Simulation 6	3*3	1000	43.23101	60%

5. CONCLUSION

Based on process and test it can be concluded that:

1. The introduction of two dimension image form pattern can be implemented by counter propagation JSB.
2. The best Learn rate grade of this method is 0.2
3. The best Momentum grade of this method is 0.5
4. The method used proven learnable and well recognized the pattern by JSB

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