

(9_0)

(Neocognitron)

**Using of Neocognitron Artificial Neural Network To Recognize
handwritten Arabic numbers**

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Abstract

Artificial Neural Networks have wide applications now a day, Among these are in the field of pattern recognition and image processing. This is due to the fact that it has a good performance and advanced mathematical computation power particularly its flexible adaptation to parallelism technique. That is why this research is conducted for the recognition of hand written Arabic numbers (0 - 9). Recognition artificial neural network is simulated the human eye for tracking the property of entered image (Feature extractor).

The systems examined on samples of Arabic numbers its performance was found to be balanced in spite of the variations in position and direction of the recognized number.

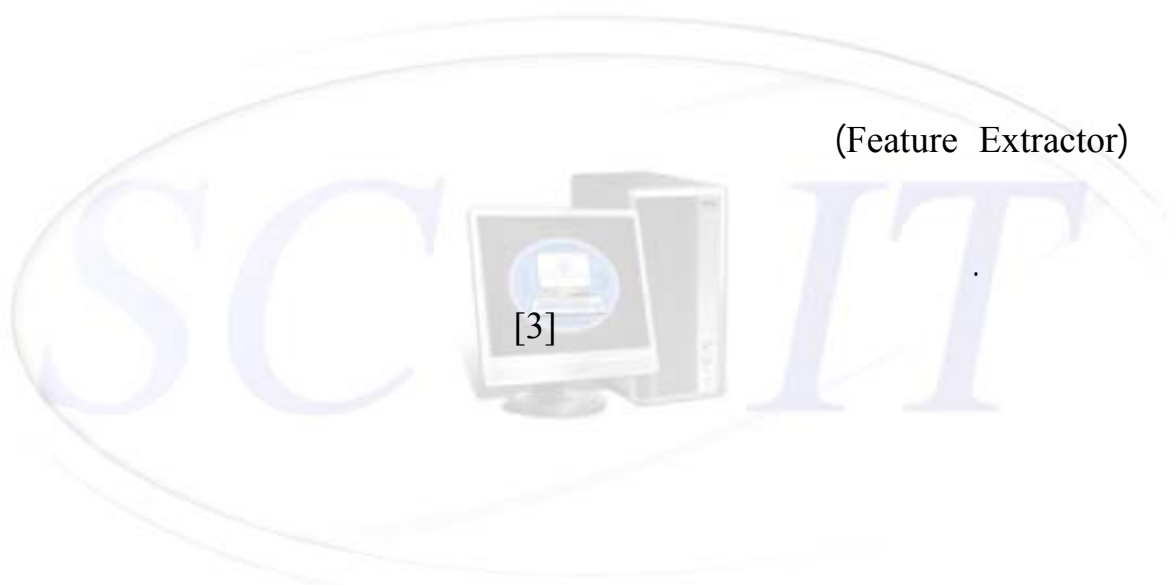
(1929)
(Template Matching) Tauschech

(mask) (Masks)

(70)
(Structural Analysis) (ANN)

[3] [2] ."

(Feature Extractor)



[3]

[8] (Gabor Filter)
(Wavelet) [4] (Frequency Domain)

(0,1,2,3,4,5,6,7,8,9) "

[7][2].

Neocognitron Artificial neural)

(Network

(Neocognitron)



(feed forward)

[13][11].

(Local Memory)

(Weight)

(Activation Function)

. [6][5]

“Cognitron”

(1975)

"

(1983)

[10][7][2] “Cognitron”

"

(U0)

U1(S1,C1),U2(S2,C2),U3(S3,C3),U4(S4,C4)

C

S

(C)

(S)

(S)

(Output Layer)

(1)

C4

[13][10][9][7][2].

1-3

(Input Layer)

(12)

(S1)

(19x19)

(19x19)

(11x11)

(8)

(C1)

[12][11][9] .(1)

S2

(S2,C2)

(11x11)

(22)

C2

(11x11)

(38)

(7x7)

(32)

(S3,C3)

(S4,C4)

"

(7x7)

(30)

(3x3)

(16)

. (1)

(C1)

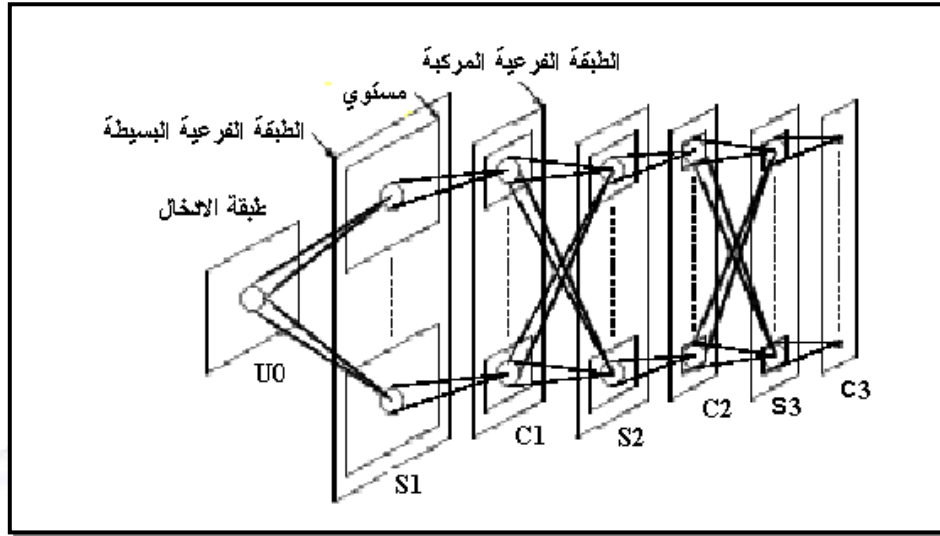
(S1)

(12) S1

C1 S1

(8) C1

[12][11][9] .(1)



شكل (1) تصميم شبكة نيوكوننترون

C1 S1 (1)

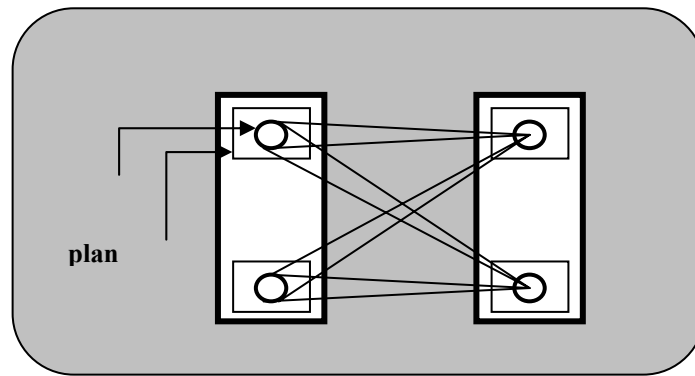
S1(1)	→	C1(1)
S1(2),s1(3)	→	C1(2)
S1(4)	→	C1(3)
S1(5),s1(6)	→	C1(4)
S1(7)	→	C1(5)
S1(8),s1(9)	→	C1(6)
S1(10)	→	C1(7)
S1(11),s1(12)	→	C1(8)

(S)

(S2) (C1) " (S) (C)

(C)

. (2)



(2)

2-3

(Input Window)

"

(Receptive Field)

(5x5) (3x3)

(1)

[11][9].

(0,1,2,3,4,5,6,7,8,9)

3-3

(Weights)

"

(3)

' 2'

(Input Layer)

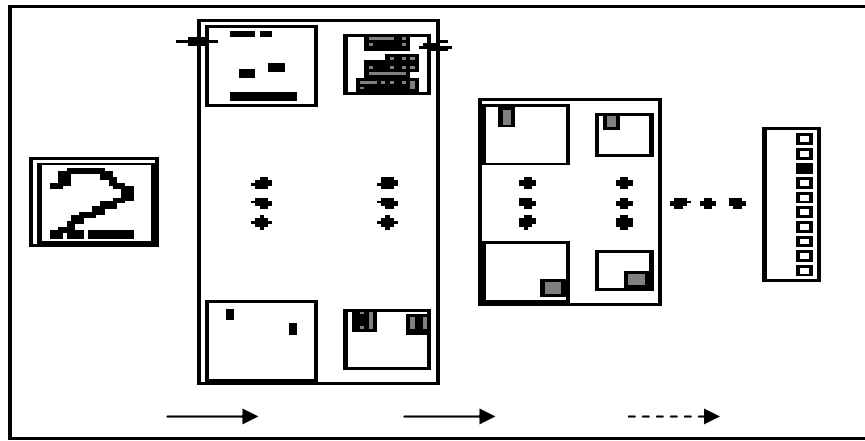
(S1,C1)

S1

"

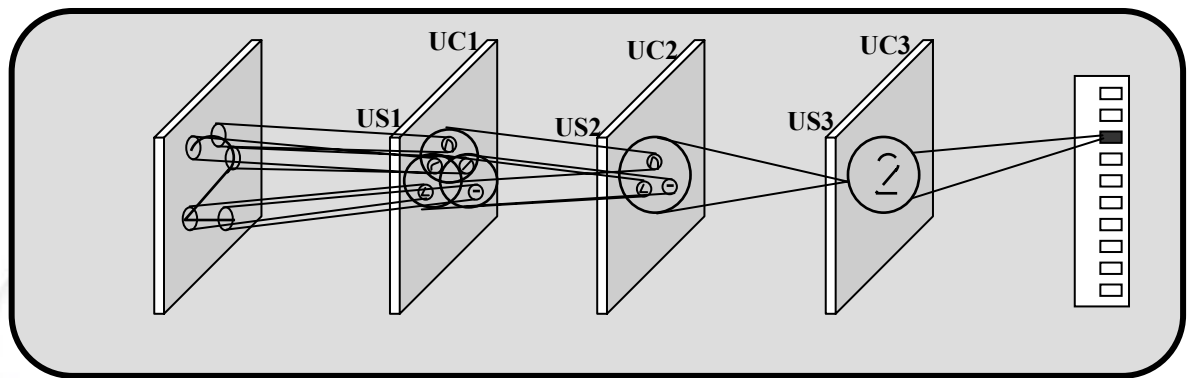
(4)

(-)



" 2 "

(3)



(4)

()

()

(3x3)

.(5)

S1

"

C1

(5x5)

(S2,C2)

()

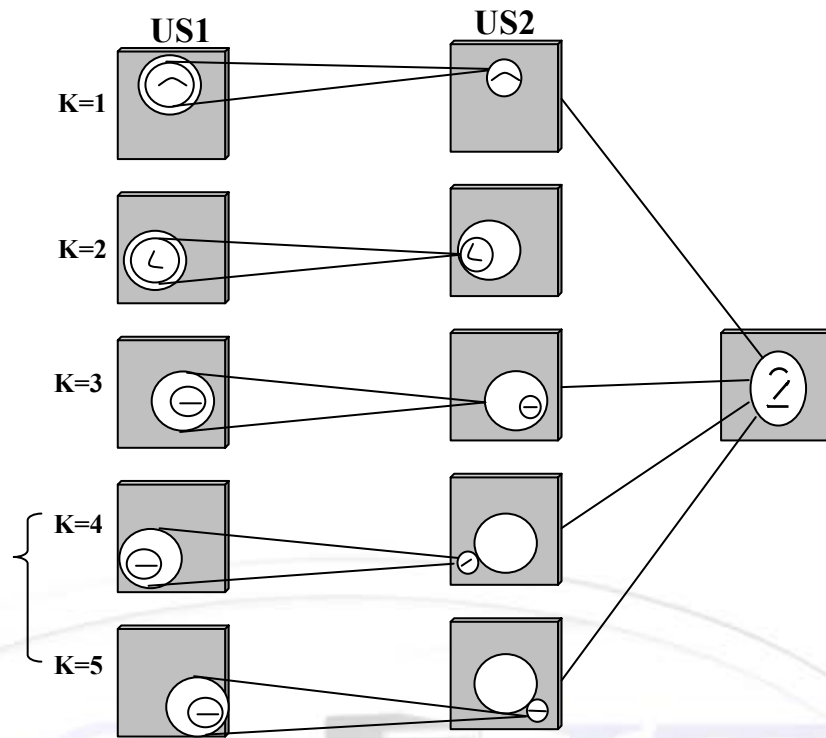
"

()

"

(2)

. (4)



(5)

-4

:

(6)

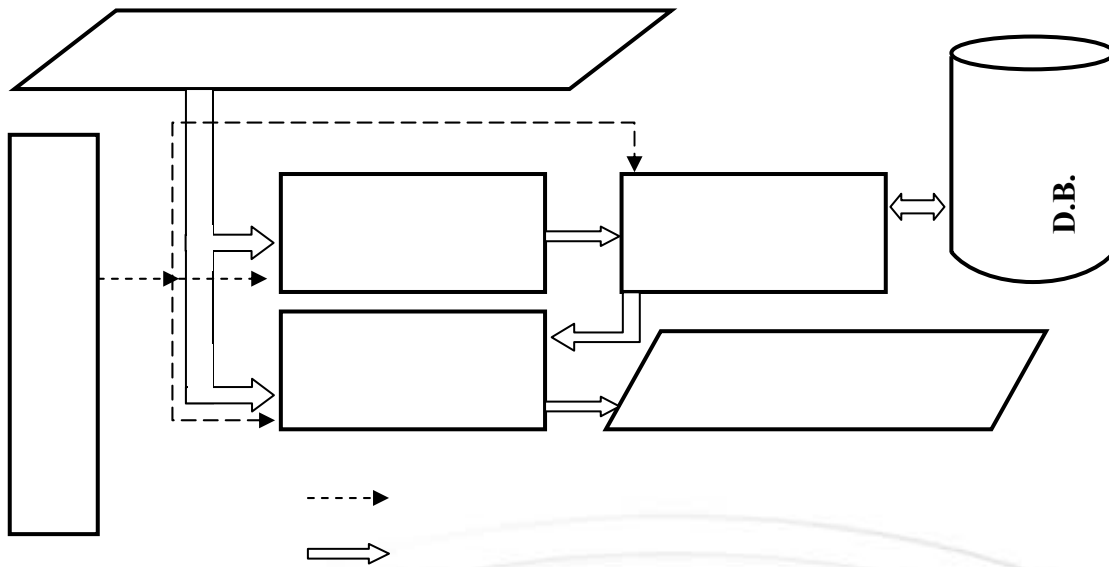
(samples)

-1

(data base)

-2

s



(6)

-5

Target) $W_{i,j}$ (input vector) :
 (Simple cells) S :
 (vector)

$$x = \frac{1 + e}{1 + h} - 1$$

$$e = \sum_i c_i \cdot w_i$$

$$h = v \cdot w_o$$

[1]

h :e
 :Wi complex Layer (C) : Ci
 :Wo V :V S (C)

.S

(S) (X)

$$F(x) = \begin{cases} X & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases}$$

(S1) e (Ci)

(complex cells) C

$$x = \frac{1 + e}{1 + h} - 1$$

$$e = \sum_i S_i \cdot W_i$$

(S) Wi Simple Layer S Si (X) (C)

$$F(x) = \begin{cases} \frac{e}{a+e} & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases}$$

(1) (3.2.1) (0.25) (a)

[2] (4)

$$\Delta w (I_{i+k,j+h}; S_{i,j}) = \alpha \cdot w(I_{i+k,j+h}; S_{i,j}) \cdot C_{i+k,j+h}$$

α W C

(U0)

(Normalization)

Bitmap (BMP)

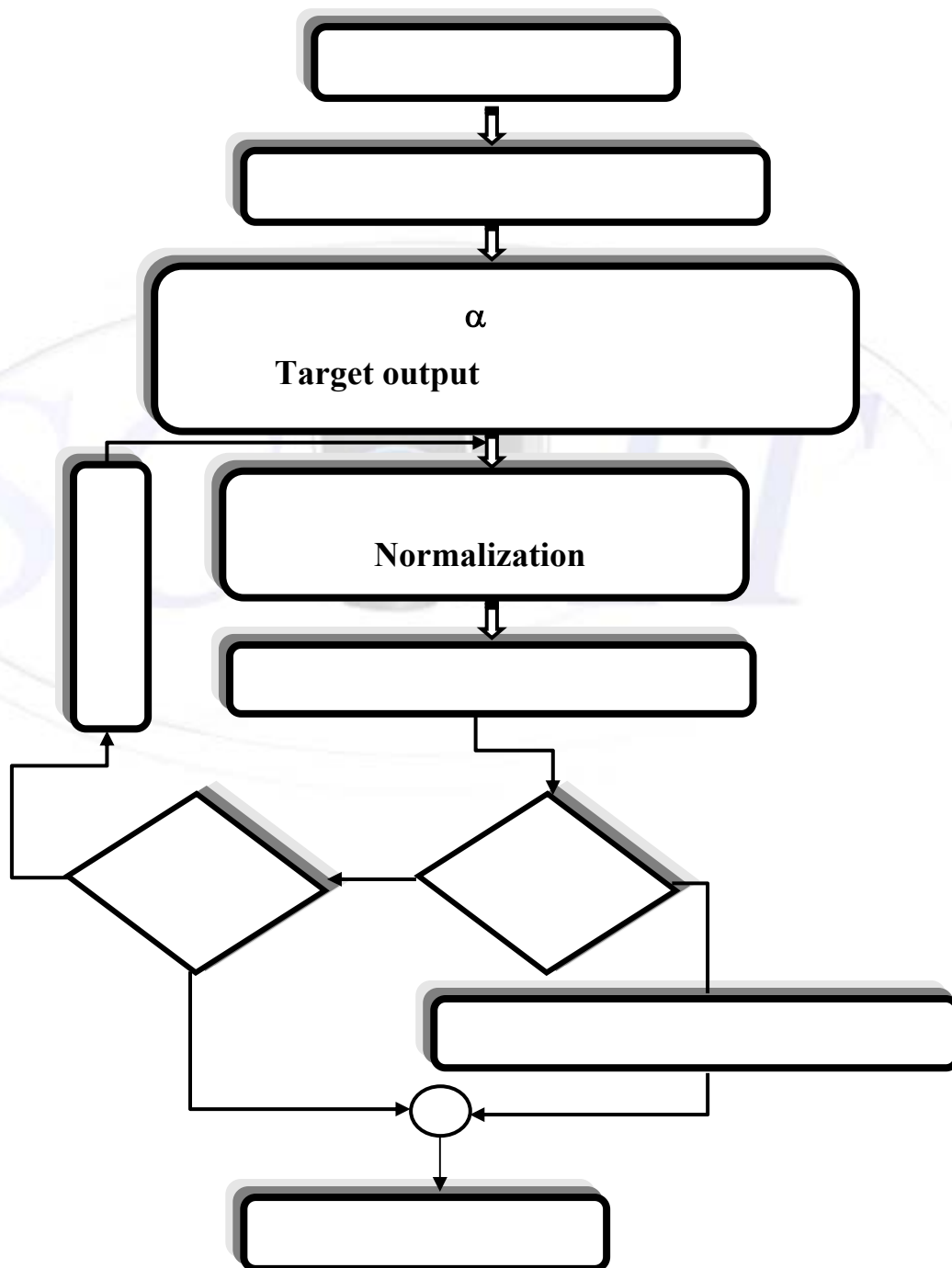
(Binary Image)

(Windows)

(9 - 0)

(BMP)
(19 × 19)

(7)



(7)

-6

:

$\%100 * (\quad \backslash \quad -1) = \text{Recognition-Rate}$

20

100)

(5
(8)
95%

0 1 2 3 4 5 6 7 8 9
0 1 2 3 4 5 6 7 8 9

(8)

-7

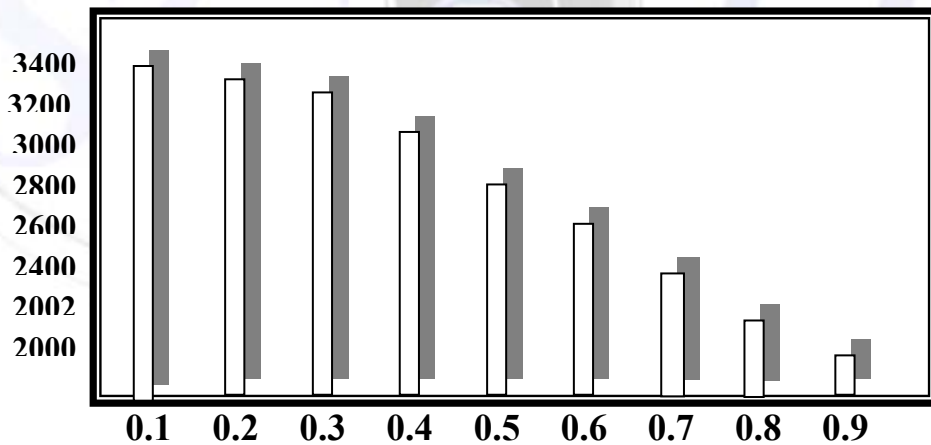
()

(0.9) "

(9) (2) (0.1) "

(2)

361	10	0.1	3311
361	10	0.2	3280
361	10	0.3	3207
361	10	0.4	3081
361	10	0.5	2771
361	10	0.6	2562
361	10	0.7	2351
361	10	0.8	2100
361	10	0.9	1820



(9)

(Iteration)

(3)

(3)

	2000	2500	3000	3311
	%85	%87.5	%90	%95

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- " (2002) [2]
- " (2002) [3]
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