NEURAL NETWORKS IN ARABIC HANDWRITING

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The recognition of written characters is a first stage of recognizing a text. The written characters are subjected to many processes; The acquiring the image that bears the text, then determining the image feature, thinning down character size, segmenting characters …etc, and the process of actual recognition.

Neural Networks are attractive methods for researchers work in pattern recognition. In this paper Back propagation Net applied for five arabic characters and the results is entirely satisfactorily. The global error of training process reached to 0.00534 at 712 training cycle.

1 Introduction

The first stage in optical characters recognition is image acquiring [6]. The input document is scanned to produce a gray-level or binary bitmapped image, then the preprocessing which we discuss in section two, after that the recognition process [1], and we implemented Backs propagation (BP) neural Network to recognize each character, it will discuss in section three, and in section four, I describe the Arabic Characters Handwriting Recognition System (ACHRS) and problems of implementation, finally, I show the development of the system and conclusion comes in section six.

2 Preprocessing Stage

For any cursive script recognition system preprocessing is very important operation as it helps reducing the affect of stylistic variation. The various operations that are carried
during preprocessing are: size normalization, Thinning, Zoning, Line segmentation, Word characters segmentation [5].

3. Back Propagation Method (BP)

Artificial Neural Network have been studied in the hope of achieving human-like performance in the fields of speech and image recognition. The back propagation net has an input layer and number of hidden layers, but theoretically no limit on the number of hidden layers, each layer is fully connected to succeeding layer finally, there is output layer [6].

4. AHCRS work

The objective is developed Arabic handwriting characters recognition system (AHCRS). The core objective is to recognize five Arabic single characters, when each characters written, our system make decision “this character is so..”.

4.1 Characteristic of Arabic Writing [7]

1. Arabic characters written from right to left.
2. The arabic symbol has some different forms or shapes when it appears alone and when it is written in the middle or, at the beginning or at the end of a word.
3. Some letters can be changed into others by the position of a dot or dots.

4. Often, some characters piled perperdiculararly to some others in one word instaid of contacting horizontally each other in succession.

4.2 AHCRS Specification

We determined 24×24 pixels for region of writing character then the Bitmap scanned from BMP file format, 1’s represent the white pixels and 0’s represent the Black ones. Then Thining process applied using the Stanford algorithm [2] ,and size normalized in 8x8 pixels.

Five characters selected Aa (١), Ba (٢), Cha (٣), Da (٤) and Ha (٥) for impelementation, each character represent class, so the net constructed of five output nodes, the desired output for each class described in table 1.

Table 1 class representation

<table>
<thead>
<tr>
<th>Class</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>أ</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ب</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ج</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>د</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>هـ</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

4.3 Results

The global error minimized until 0.005340 and convergence at cycle 712. The
sample space consist of 100 pattern for each character. The output values closed by greater than 0.95, and those near to zero closed to it by less than 0.5.

We find that any initialization values effect positively or negatively in training rate, global error and convergence point. When we determine same values for weights on links of input, hidden and output layer connection, the global error decrease and increase. When samples generated randomly, there is probability that many samples may repeat, but if number of right samples increase then error decrease.

The parameter ($\theta_0$) showed in activation function [4] in equation 1 bellow effected results, so the value of parameter determined in the interval $[-103,18]$ of sumation inputs to sigmoid function, so the suitable value for the parameter set to 10 for all hidden layer nodes and 2 for all output layer nodes.

$$h_j(I_j) = \frac{1}{1 + \exp[-(I_j + \theta_j)/\theta_0]}$$

... (1)

As shown in Delta rule [3] represented in equation 2, two parameters $\eta$ and $\alpha$ influenced the performance.

$$W_{ji}(t+1) = W_{ji}(t) + \eta \delta_j Y_i + \alpha[W_{ji}(t) - W_{ji}(t-1)] \quad 0<\alpha<1$$

... (2)

When value of parameter $\eta$ increase, the iteration decrease, but parameter $\alpha$ gives good results when it set to values $\{5,6,7\}$ see table 2 bellow.
Table 2 Influence of parameters when initial values for all experiments remained constant

<table>
<thead>
<tr>
<th>Hidden $\eta$</th>
<th>Input layer $\eta$</th>
<th>$\alpha$</th>
<th>Cycle</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.9</td>
<td>0.7</td>
<td>505</td>
<td>0.009497</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td></td>
<td>371</td>
<td>0.009499</td>
</tr>
<tr>
<td></td>
<td>0.3</td>
<td></td>
<td>353</td>
<td>0.009446</td>
</tr>
<tr>
<td></td>
<td>0.1</td>
<td></td>
<td>399</td>
<td>0.009300</td>
</tr>
<tr>
<td>0.5</td>
<td>0.9</td>
<td>0.7</td>
<td>402</td>
<td>0.009488</td>
</tr>
<tr>
<td>0.7</td>
<td>0.9</td>
<td>0.5</td>
<td>320</td>
<td>0.009457</td>
</tr>
<tr>
<td>0.5</td>
<td>0.9</td>
<td>0.5</td>
<td>348</td>
<td>0.009329</td>
</tr>
<tr>
<td>0.3</td>
<td>0.9</td>
<td>0.5</td>
<td>404</td>
<td>0.009461</td>
</tr>
</tbody>
</table>

If we increase the number of hidden layer, error decrease and convergence being faster, but the error increased when the number set to more than 20.

1.5 Development of AHCRS system

The system developed to recognize disconnected characters words. The architecture of the system describes bellow:

1. let image size is $72 \times 24$ pixels, and acquire bitmap of the image.
2. Make thinning ,and split each character in the word.
3. Set the size splited to $24 \times 24$ pixels, then scale to $8 \times 8$.
4. Recognize each character then match collected characters with characters of words stored in database ,and recognize the word.

5. Conclusion

To develop learning model, we specified the OCR objectives and problems by providing the
problem oriented approach. As statistical representative subset of cases selected and trained. The learning time depends on many factors such as the initialization of weight, parameters values, number of cells in hidden layer, samples space and type of samples and activation function.

6. References

3. Lin Yaorui, “Neural Networks Lecture notes”, Beijing, China, Tsinghua University, 1996.