COMPUTATIONAL ANALYSIS OF HANDWRITTEN NUMERALS USING ANN AND PSO WITH MUTATION

Arijit Sarkar , S S Thakur , Shampa Sengupta , Aurpan Majumder *
MCKV Institute of Engineering, Howrah(W.B)
* NIT Durgapur.
electro_tcom@rediffmail.com

Abstract: Hand written numeral recognition is one of the emerging areas in Computer Science related applications. This paper describes the application of Artificial Neural Network in Numerals recognition especially from handwritten documents for both the Bengali as well as English Numerals. The paper also deals with the computational analysis on the recognition output obtained from the neural network with the help of particle swarm optimization technique. The contribution to the research area from this paper is that, the proposed algorithm with PSO depicts that the normal training and testing efficiency obtained from the existing dataset is higher than the training testing efficiency with neural network based approach. The Present paper also focuses the PSO with mutation concept. The said work can be extended to the hybridized approach with the application of genetic algorithm along with other optimization technique like ACO (Ant colony optimization), and BFO etc.

1. INTRODUCTION

Pattern recognition a topic of machine learning is "the act of taking in raw data and taking an action based on the category of the data". Most research in pattern recognition is about methods for supervised learning and unsupervised learning. The patterns to be classified are usually groups of measurements or observations, defining points in an appropriate multidimensional space. Recognition is a process of establishing a match between some new stimulus and previously stored stimulus patterns.

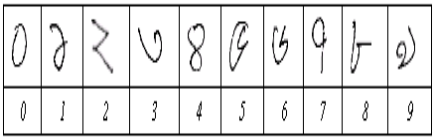
2. FEATURE EXTRACTION TECHNIQUE

The Preprocessing steps involved the following stages: [1]
Image Sensing and Acquisition
Image Sampling And Quantization Representing Digital Images
Thresholding
Binarization

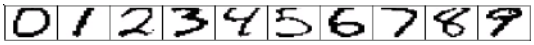
2.1 Feature Extraction

Any object or pattern, which can be recognized and classified, possesses a number of discriminatory features or properties. More preciously, features are the measured descriptive of a pattern which characterizes the membership of a pattern in a certain class. The task of feature extraction is to reduce the data by measuring “features” or “properties” that distinguish between different numerals. These features are then passed to a classifier that evaluates the evidence presented and makes a final decision. Feature selection and extraction plays an important role in pattern recognition.

Typical digit patterns of first ten natural numbers (0 to 9) taken from Bengali and English scripts are shown in the adjoining figure.



The decimal digit set of Bengali Script



The decimal digit set of English Script

2.2 Feature Extraction Schemes

The feature sets selected for the present work consists of 24 shadow features, 36 additional longest run and 16 concentration features.

Shadow Feature Extraction

For computing shadow features, each character image is enclosed within a minimal square, divided into eight octants. Lengths of projections of character images on three sides of each octant are then computed. Each such length is then being divide with the maximum possible length of projection on the respective side to extract one feature.[3] Finally all such projections on each of the 24 sides of all octants are summed up to produce 24 shadow features of the character image under consideration. For taking the projection of an image segment on one side of an octant, existence of a fictitious light source in the opposite side is assumed.

Longest Run Feature Extraction

For computing longest-run features from a character image, the minimal square enclosing the image is divided into 9 overlapping rectangular regions.

Coordinates (r, c) of top left corners of all these regions are given as follows: {(r, c) | r=0, h/4, 2h/4 and c=0, w/4, 2w/4}, where h and w denote the height and the width of the minimal square respectively. In each such rectangular region, 4 longest-run features are computed row wise, column wise and along two of its major diagonals. [7]

The row wise longest-run feature is computed by considering the *sum* of the *lengths* of the *longest bars* that fit consecutive black pixels along each of all the rows of a rectangular region. The three other longest-run features are computed in the same way but along the column wise and two major diagonal wise directions within the rectangle separately. Thus, in all, 9x4=36 longest-run features are computed from each character image.

Concentration Feature Extraction

In this technique for the concentration of Black pixel for every octant we found out the mean value along X-direction & Y-directions. Mean values what we get are normalized. We get 16 features i.e. 2 normalized values in two directions from one octant.

So from above described three feature extraction technique we get total 24+36+16=76 feature for a character image which is to be recognized.

3. IMPLEMENTATION & RESULT

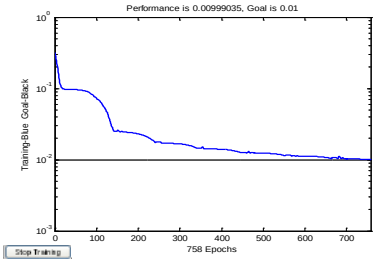
The Present work has implemented Artificial Neural Network based supervised learning approach Using Back Propagation algorithm. The Result is shown below.

ENGLISH DATA SET:

logsig, logsig	Train efficiency (%)	Test efficiency (%)
20,10	95.05	94.35
30,10	95.35	94.90
40, 10	95.32	94.55
50,10	95.38	94.75
60,10	95.45	94.95
70,10	95.62	**95.10**
80,10	95.20	94.80
90,10	95.57	95.05
100,10	95.50	94.75
110,10	95.42	94.85
120,10	95.72	94.55

From the Table it is clear that the maximum test efficiency 95.10% for the combination of (70, 10) neurons.

From the Table it is clear that the maximum train efficiency 95.72% for the combination of (120, 10) neurons.



Bengali Data Set

For Bengali Feature Set we can calculate the train & test efficiency each & every time we are varying the number of neurons(10,20,30,……) in the hidden layer but the output layer's neuron always constant(10).

For Bengali data set it has been tested that the maximum test efficiency 94.35% for the combination of (90, 10) neurons.

From the Table it is clear that the maximum train efficiency 95.62% for the combination of (120, 10) neurons.

4. PARTICLE SWARM OPTIMIZATION

Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation.[7] In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles.

5. THE PSEUDO CODE OF THE PROCEDURE IS AS FOLLOWS

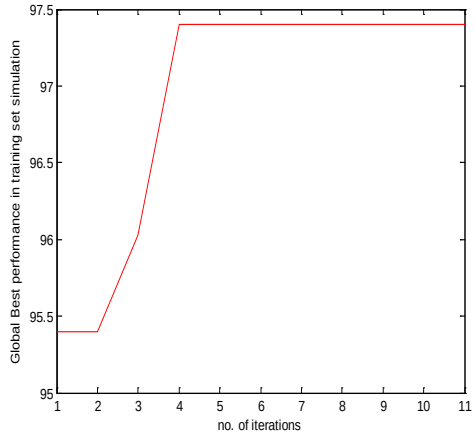
```
Foreach particle
   Initialize particle
END

Do
   For each particle
    Calculate fitness value
      If the fitness value is better than the best fitness
value (pBest) in history
            set current value as the new pBest
   End
```

Choose the particle with the best fitness value of all the particles as the gBest
For each particle
Calculate particle velocity according equation (a)
Update particle position according equation (b)
End

6. RESULTS

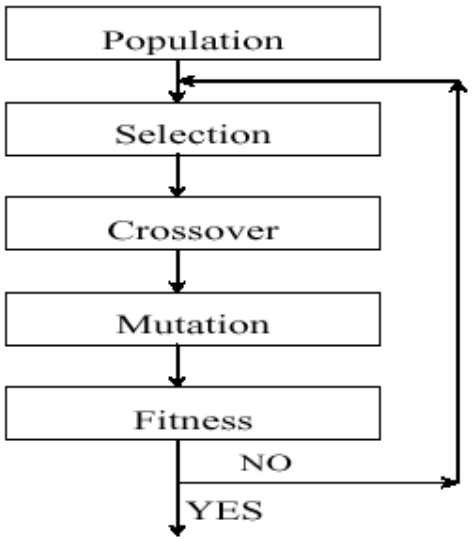
The correct percentage for training set recognition
97.4000
>> pos
pos = 4

SIMULATION OUTPUT USING PSO.



7. COMPUTATIONAL ANALYSIS & GENETIC ALGORITHM BASED OPTIMIZATION

Mutation operation in GA introduces variations into the chromosomes. This variation can be global or local. The operation occurs occasionally (usually with small probability Pm) but randomly alters the value of a string position.
Each bit of a bit string is replaced by a randomly generated bit if a probability test is passed. Within a specific probability, certain digits will be altered from either 0 to 1 or 1 to 0 in binary coding.



The Present paper also analyses the computational analysis of the output with PSO and PSO without mutation.
The correct percentage for training set recognition 29.7750

8. ACKNOWLEDGEMENT:

The authors are acknowledged to Prof. Somsubhra Talapatra of BESU, Shibpur for his valuable suggestions & Support.

9. REFERENCES:

[1].Rafael C. Gonzalez, Richard E. Woods , and Eddins, " Digital Image Processing Using MATLAB" Pearson Education 2004.

[2].Konar Amit "Computational Intelligence Principles", Techniques and Applications Springer Berlin Heidelberg New York 2005.

[3].Kuo-chin and Mei-Lin Chang, " Form document identification using line structured based features," In 14th International Conference on Pattern Recognition ICPR'98 Brisbane, Australia, August1998.

[4]. A. Amin "Off-Line Arabic Character Recognition: The State of the Art", Pattern Recognition, vol. 31, No. 5. pp. 517-530, 1998.

[5.] Jiang Xiongwei , Xie Hengkun , Wu Guangning "A Neural Network Used for PD Pattern Recognition with Genetic Algorithm," Proceedings of The 6th International Conference on Properties and Applications of

Dielectric Materials June 21-26, Pp 451-455,2000.

[6]. K. G. Khoo and P. N. Suganthan Structural Pattern Recognition Using Genetic Algorithms With Specialized Operators IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART **B:** CYBERNETICS, VOL. 33, NO. 1, FEBRUARY 2003

[7] Arijit Sarkar ,Aurpan Majumder , Avijit Bose"ANN IN NUMERALS RECOGNITION & OPTMIZATION USING PSO" at CTCS-2010 at Assam University, 22-24 February 2010.