PARTICLE SWARM OPTIMIZATION METHODOLOGY FOR CLASSIFICATION OF IMAGES

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Abstract: In this paper how Particle Swarm Optimization Radial Basis Function Neural Network is used for solving pattern recognition issues is discussed. To improve the pattern recognition efficiency PSO technique is used to find the weights and bias values and k-means algorithm is used to find the centroid values of the radial basis function neural network. Finally proved that this method shows better accuracy than the traditional RBF model.

Index Terms- Particle Swarm Optimization, Neural Network, Pattern Recognition, Radial Basis Function Network

I. INTRODUCTION

Particle Swarm Optimization (PSO) is a recently developed numerical method for optimization, which is simple, easy to apply and has a strong smart background, and it has been used in many fields such as function optimization, and pattern recognition. Particle Swarm Optimization algorithm is used to proceed global dynamic searching. PSO uses only one Swarm. Swarm is a collection of particles PSO is a simple method used to optimize the solution of problems with regards to the given requirement through iterative method.PSO has many particles and these are moving in the region of search–space based on the formula that consists of position and velocity. Every particle is affected by local positions and tries to reach the best positions in the search-space, which are updated as best position calculated by other particles. This leads the swarm to move in the direction of best solution. This method is used to find weights and bias values of RBFNN. In PSO initially all bias and weights are defined with random values and then move to optimal solutions. The solution of PSO is called particles; these are going through the problem space by following the current optimum particles. This paper is using a new method for image classification called Particle Swarm Optimization.

II. THE PROPOSED METHODOLOGY ARCHITECTURE

This paper has been analyzed in different designs of the Radial Basis Function Neural Network using traditional and PSO. The Figure 1 explains the Conceptual Outline of this paper. There are mainly four blocks shown in the diagram. The main part is in the third block. The third block shows Neural Network models which include two methods and they are as follows:

1. Traditional Radial Basis Function Neural Network (TRBF)
2. Particle Swarm Optimization RBF Neural Network (PSO RBF)

The above two methods are extensions of basic RBF Neural Network design. They are improved under some new aspects of these methods. The Radial Basis Function Neural Network (RBF NN) is a three layer design with weights and bias optimization values. Mainly our research focuses on computing optimization values using optimization methods. The Figure 1 shows that proposed methods improvement in RBF NN.

To compare the performance of several image features for retrieval systems or applications, bench mark image data sets used. This work uses Corel image data set. Generally in Radial Basis Function, input layer consists of input data which is extracted from image features. This work used different dimensions of the image features like Color, Texture, and Wavelet.

In the hidden layer, it contains one more additional node than input node. This layer consists of centroids which are calculated using the following two methods.
1. Random
2 .K-means clustering algorithm.
The above methods use Gaussian distribution function internally. In this work weights among hidden and output layers are computed with the following three optimization methods.
1. Inversion Matrix
2. PSO
Outputs are computed from processing layer and hidden layer plus Bias values. Generally Bias values are computed using PSO.
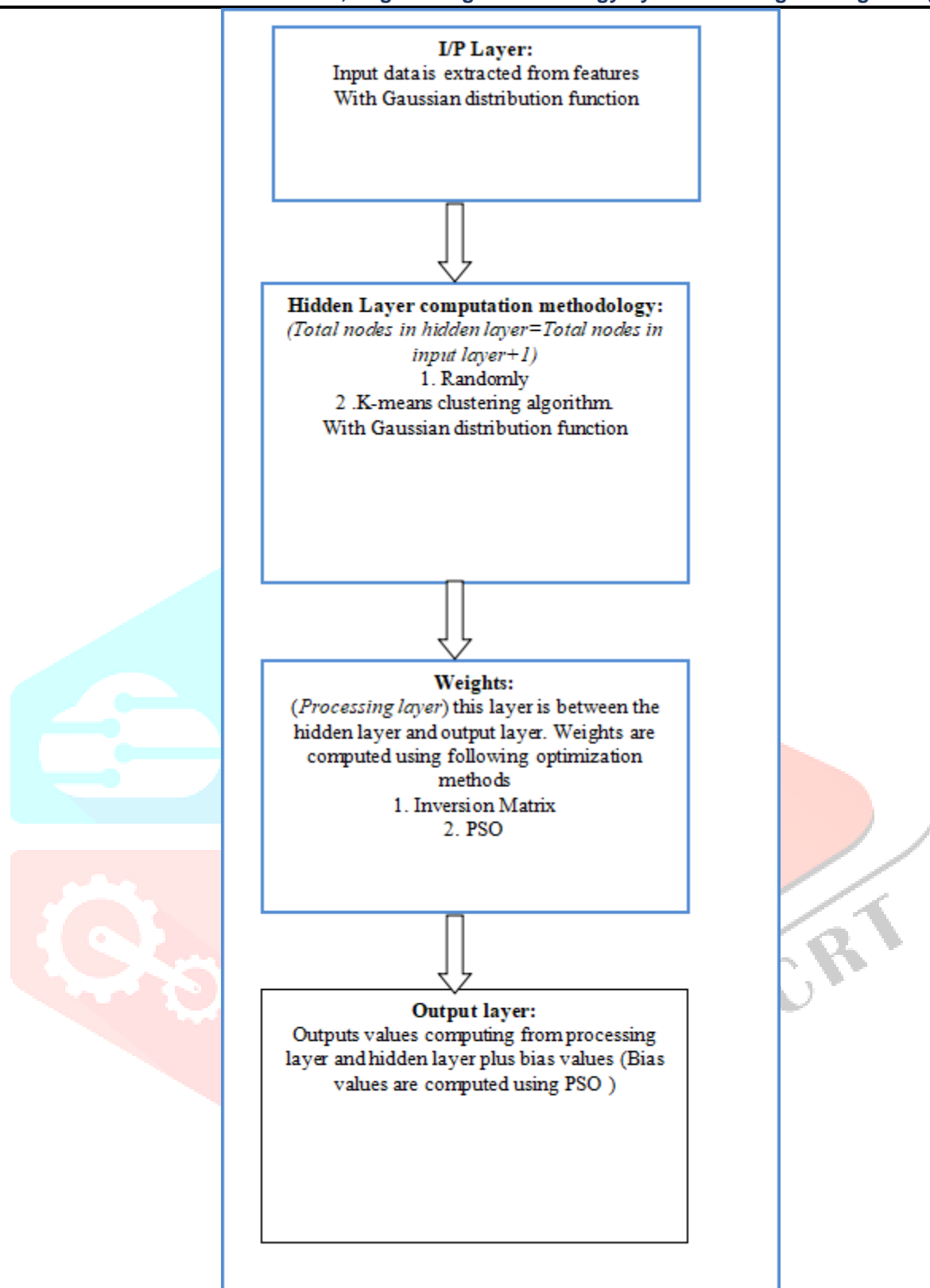
I/P Layer:
Input data is extracted from features
With Gaussian distribution function

Hidden Layer computation methodology:
(Total nodes in hidden layer=Total nodes in input layer+1)
1. Randomly
2 .K-means clustering algorithm
With Gaussian distribution function

Weights:
(Processing layer) this layer is between the hidden layer and output layer. Weights are computed using following optimization methods
1. Inversion Matrix
2. PSO

Output layer:
Outputs values computing from processing layer and hidden layer plus bias values (Bias values are computed using PSO)

Figure 1 Architecture of the PSO

III. THE FLOWCHART

Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. This optimizes a problem by having a population of candidate solutions, here each particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best
known position but, is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions. Using Particle Swarm Optimization RBF Neural Networks weights and bias values are defined.

PSO-RBF Neural Networks uses image retrieval process using local minimum and global minimum. Swarm is a collection of particles. Each particle has five properties, they are position, error, velocity, bestPosition (Pbest) and bestError (Perror). PSO uses only one Swarm. Each Swarm has GlobalBestPosition (Gbest) and GlobalBestError(Gerror). Particles are moving in best direction based on MSE of the RBF. Each

moved position compare with self bestError and GlobalBestError. Based on best values, Particle is updated with new position and updated GlobalBestPosition with BestPostition values.

Following are steps to compute Radial Basis Function weights and bias values.

Using Particle Swarm Optimization identify the weights and bias values for RBF Neural Networks.

- Totally 290 (28*10+10) numerical values are required to compute for the first training set.
- Following are the steps to find values:
  - Particle initialize:
    - **Position:** Random values (290) are between min and max values. Min and Max values are defined -10 and 10.
    - **Position Error:** using initial position values compute K-Means Radial Basis Function network.
    - Find the MSE values
    - *Velocity:* Random values (290) are between min and max values.
    - **Particle Best Position (Pbest):** Initial position values set is Particle Best Position
    - **Particle Best Error (Pbest Error):** Initial position error is Particle Best Error.
  - Initial Find Best Global Position and Error based on all Particles
  - The next movement of the Particle based on Current Position and New Position.
    - (Particle movement only with Epochs, initial defined 100)
    - W inertia weight, C1 Local cognitive , C2 Global cognitive and r1 and r2 are random variables.
    - newVelocity(j) = (w * currP.velocity(j)) + (c1 * r1 *   (currP.bestPosition(j) - currP.position(j))) +(c2 * r2 * (bestGlobalPosition(j) - currP.position(j)));
    - New Position= Current Position + New Velocity
    - Find the MSE for New Position (Values)
    - If want move Particle from current to New Position, Error should be less compare with Pbest Error, Else Particle in current position.
    - If New Position Error is less than Global Best Error (Swarm Best), then update the Global Best Error and Position.
    - Particle selected randomly and movement up to number Epochs.
  - Final find the Best Global Position (Gbest) and Error.
  - Using this Gbest values, design the best PSO-Radial Basis Function Neural Network

In Particle Swarm Optimization main formal is,

newVelocity(j) = (w * currP.velocity(j)) + (c1 * r1 * (currP.bestPosition(j) - currP.position(j))) +(c2 * r2 * (bestGlobalPosition(j) - currP.position(j)))…(6)

   Based on new Velocity, it will change the Particle position. One of the disadvantages of Particle Swarm Optimization is that only one Swarm limit of mathematical space. This is resolved by using Multi Swarm Optimization.
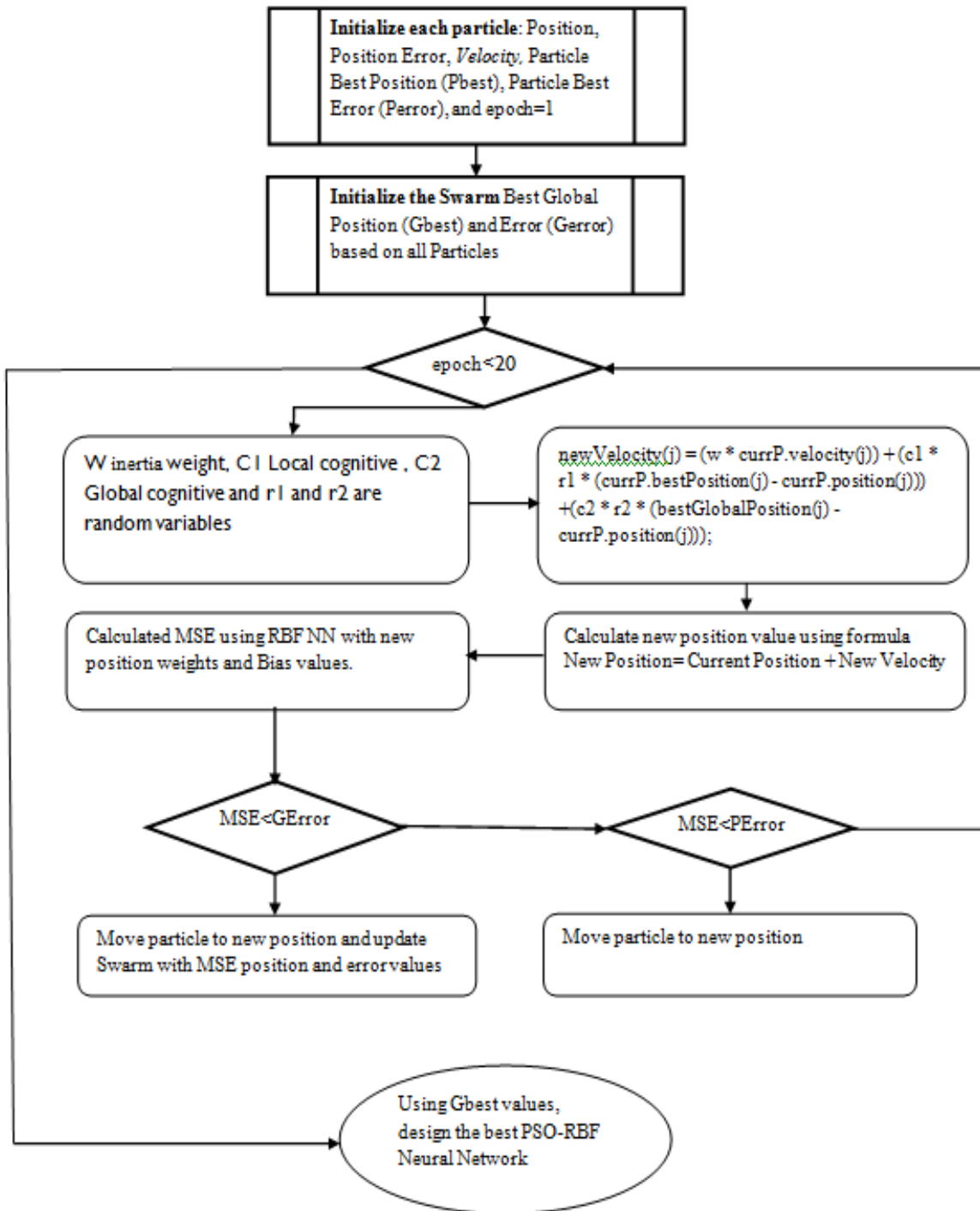
Figure 2 Flow Chart

IV. RESULTS

Data is collected from the Corel image database. Corel is available with 1000,5000,10000 images. For all these images extracted 27 features. These 27 Data features divided as three parts.

1. Color (Count -3): Mean value of each of the color spaces are chosen as color   features [7].
2. Texture (Count -12): Variance, Coefficient of Variation, Energy and   Entropy is calculated for each Color [7].
3. Wavelet features (Count -12): Decompose an image into sub-bands at one level with Approximation, Horizontal, Vertical and Diagonal for each color [7][8].

Using 1000 images, the following cases are defined for analyzing accuracy results, here all test data selected randomly. The test data are taken different values like 50,200,300,500,600,800 also the train data are considered as 950,800,700,500,400,200.

Parameters used for the proposed system

Table 1: Parameters used in the experiment

Paramater	Values
No of input nodes	27(No. of Features)
No of Hidden Nodes	28 (No. of input nodes +1)
No of Output Nodes	10 (No. of Classes)
Driving Function	Gaussian radial function
Learning Algorithm	MSE
Network	PSO RBF
Epochs	40
Goal	0.1 (error)
Standard Deviation	4
No of Swarms	100
No of particles for Swarm	100
Space Min and Space max	-10 and 10
W	0.72
r1 and r2	Rand value (between 0 and 1)

Performance Comparison

Table 2: All the cases with accuracy values for different systems

# Test Data	RBF	PSO-RBF
50	58	84
200	51.5	73.5
300	51	76.33
500	53.2	71.8
600	48	76.17
800	38	72.12

Finally, the present research demonstrates that the new method PSO RBF has better accuracy in comparison with other methods even in the case of when test data is very high and with less train data.
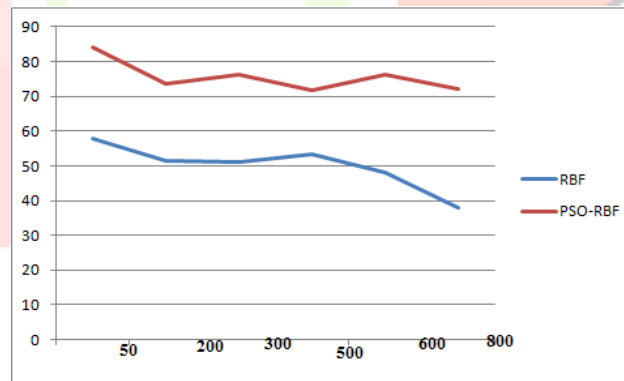

Figure 3 Comparison of accuracy values for various systems

V. CONCLUSION

In this paper accuracy assessment of images using traditional RBFNN and PSO RBFNN is emphasized. Traditional method has given 58, 51.5, 51, 53.2, 48 and 38% of test accuracy. This method uses Centroids values randomly and Weights and Bias values are calculated using Inversion Matrix method. Accuracy can be improved by defining proper weights and bias values, to improve the accuracy in this paper focused to use the right method for solving this problem that is Particle Swarm Optimization. Using PSO constructed best PSO-Radial Basis Function Neural Networks. This method achieved best accuracy results for different dynamic cases. PSO-RBF produced the following accuracy for test data: 84, 73.5 76.33, 71.8, 76.17 and 72.12%   Test accuracy values .Compare with all existing methods, our research proposed method is more accuracy. Finally, PSO-RBF NN has given better results in the image classification over traditional RBFNN method.

REFERENCES

[1] Jagriti Sharma1 and Sunali Mehta2", Training of Radial Basis Function Using Particle Swarm Optimization", International Journal of Engineering Research and Development e-ISSN : 2278-067X, p-ISSN: 2278-800X, Volume 7, Issue 10 ,July 2013, PP. 01-10.
[2] Qinghai Bai ,"Analysis of Particle Swarm Optimization Algorithm",CIS,Vo3,No1,Feb 2010

[3] Kennedy, J. ad Mendes, R,” Population Structure and Particle Swarm Performance”, Congress on Evolutionary Computation, 2002, pp. 1671-1676

[4] Majid Moradi Zirkohi, Mohammad Mehdi Fateh and Ali Akbarzade ,” Design Of Radial   Basis Function Network Using Adaptive Particle Swarm Optimization And   Orthogonal   Least   Squares. Software Engineering & Applications”, 2010, 3, 704-708

[5] Min Han, Member, IEEE, Wei Guo, Yunfeng Mu,”A Modified RBF Neural Network in   Pattern Recognition”, Proceedings of International Joint Conference on Neural   Networks, Orlando, Florida, USA, August 12-17, 2007

[6] Nabney IT, “Efficient training of RBF networks for classification”, Proceedings of 9th ICANN, Volume 1, pp 210– 215.