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Design Efficient Image Compression Algorithm for Gray Scale Image Using RBF and SOM Neural Network

Shailesh Saxena ResearchSchloar[1], Dr. R. P. Singh Professor[2]
[1,2]*Sri Satya Sai University & Medical Sciences, Sehore, India*

Abstract: *Image compression is important phase of computer vision. The compression of image reduces the size of data and increase the efficiency of data transmission over the internet. Now a day's various authors proposed image compression technique based on neural network model. The used neural network model is very efficient for the process of compression, but the rate of compression is very slow. In this paper proposed the hybrid model of image compression using the combination of RBF and SOM neural network model. The RBF neural network model estimates the trained pattern for the compression process of SOM neural network. For the processing of data in neural network model used discreet wavelet transform function. The proposed algorithm simulated in matlab software and measure standard parameter such as PSNR, compression rate and compression ratio. The proposed algorithm gives better result instead of other neural network based image compression technique.*

Keywords: *Image compression, WT, SOM, RBF.*

I. Introduction

The advancement of digital device and technology increase the quality and reliability of image creation and generation. The generation and creation of image required the compression technique for the storage purpose and transmission purpose [1,2,3].The current age of technology deals the fast compression and fast transmission of digital data. For the compression of image used various technique based on different domain of processing unit[4,5,6]. The neural network based image compression technique is very efficient instead of other image compression technique. The umbrella of neural network provides various models for the image compression. Some model is used such as SOM neural network model and RBF neural network model [7]. In this paper proposed the hybrid model for the image compression based on RBF and SOM neural network model. The RBF neural network processing is very fast in compression of other model. The RBF neural network work here for the generation of similar pattern. The similar pattern generates the path of cluster. The path of cluster is input of SOM neural network model. The SOM neural network model is dynamic unsupervised model for the processing of path data and creates cluster for the creation of index and finally image is compressed. For the index formation used head code coder, the head code coder creates the index of cluster map pattern for the compression process. In family of transform function gives one member is called fractal transform function. Basically the fractal transform function is loosy image compression technique. But in this work fractal transform function work as lossless image compression. The fractal transform function used the property of similarity. The property of similarity index combined the data in from of processing in terms of compression. On the whole, the FACTRAL algorithm makes full use of the characteristics of wavelet coefficients involving the energy clustering and the energy attenuation along with the increase of scalability. Furthermore, buying combining the quad tree partition with the bit-plane encoding, this method can nearly achieve the same compressing performance with the SPIHT. However, there still exists some improvement to be done as for the achieving speed and memory usage in spite of its Coding independently, fast coding speed and so on. The rest of paper organized in section II neural network model sections III discuss proposed model. In section IV discuss experimental result analysis and finally discuss conclusion and future work.

II. Neural Network Model

In this section discuss the neural network mode for the image compression. For the purpose of image compression used two model SOM neural network model and RBF neural network model[11]. The SOM neural network model is unsupervised neural network model and self-learning model and very efficient for the generation of pattern cluster. The RBF neural network model is very fast single layer network for the processing of data. The RBF neural network trained the pattern for the processing of SOM input. In this paper combined both mode and used for the process of image compression. Here discuss both models. The SOM can thus serve as a cluster analyzing tool of high-dimensional data. Also, the SOM has the capability to generalize and Generalization capability means that the network can recognize or characterize inputs it has never encountered before. A new input is assimilated with the map unit it is mapped to.

Input & Output
Training data: vectors, X
Vectors of length n

$x_{1,1}x_{1,2}x_{1,3}\ldots\ldots\ldots x_{1,i}\ldots\ldots\ldots x_{1,n}$

$x_{2,1}x_{2,2}x_{2,3}\ldots\ldots\ldots x_{2,i}\ldots\ldots\ldots x_{2,n}$

..

..

...

$x_{j,1}x_{j,2}x_{j,3}\ldots\ldots\ldots x_{j,i}\ldots\ldots\ldots x_{j,n}$

...

...

$x_{j,1}x_{j,2}x_{j,3}\ldots\ldots\ldots x_{j,i}\ldots\ldots\ldots x_{j,n}$

(p Distinct training vectors)

Vector components are real numbers
Outputs
A vector, Y, of length m: $(y_1, y_2, \ldots, y_i, \ldots, y_m)$
Sometimes $m < n$, sometimes $m > n$, sometimes $m = n$
Each of the p vectors in the training data is classified as falling in one of m clusters or categories
That is: Which category does the training vector fall into?
Generalization
For a new vector: $(x_{j,1}, x_{j,2}, \ldots, x_{j,i}, \ldots, x_{j,n})$
Which of the m categories (clusters) does it fall into?

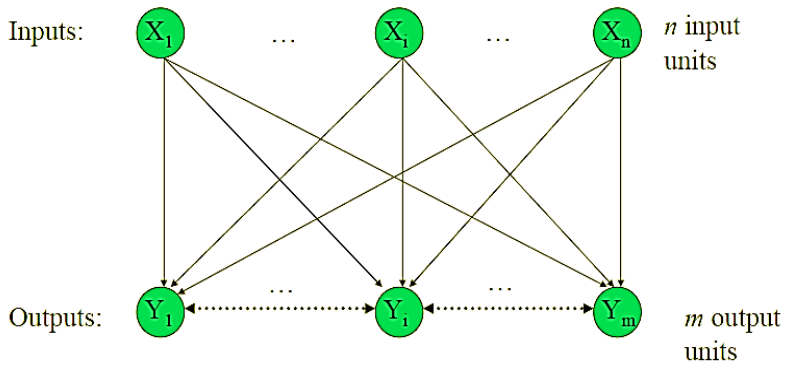

Figure 1 Neural Network

III. Proposed Algorithm

The hybrid compression is a combination of two independent neural network models. The combination of SOM and RBF neural network model build hybrid compression technique. The processing of SOM and RBF neural network is integration of clustering and classification. The process of SOM neural network is produces the cluster map of image data. These feature map data process the input of RBF neural network. The RBF neural network produces the classified pattern. This classified pattern process the similarity matching of image compression.

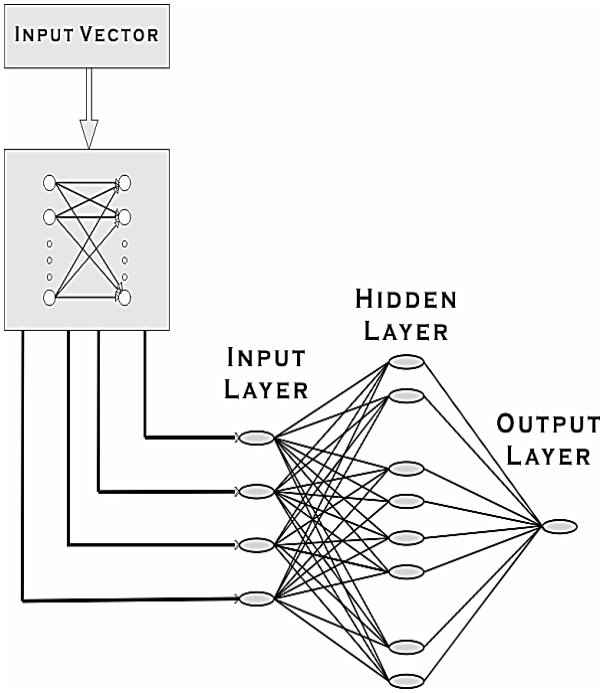

Figure 2 shows data block diagram of hybrid classifier.

The processing step of hybrid compression, the output of feature map into x1,x2,x3,,,,,,,,,,,,,,,xn
Step1 initialization: - choose random values for the initial weight vector Wj(0). The only restriction here is that the initial weight vector Wj(0) must be different for j=1……l, where l is the number of output neurons.
Step 2 similarity matching: - finding the winning neuron Yc at time step t by using minimum distance Euclidean criterion.

$$Yc = argmin\|x(t) - wj(t)\|, j = 1,2, \ldots . . l \ldots \ldots (1)$$

Step 3 updating: - adjust the synaptic weight vector of all neurons by using update rule

$$Wj(t+1) = wj(t) + \eta(t)\hbar i, Yc(t[x(t) - Wi(t)]) \ldots \ldots \ldots \ldots \ldots \ldots . . (2)$$

Where $\eta(t)$ is learning rate and hi.yc(t) is the neighborhood function centered around the winner.
Step 4 Continuation:- go back to step 2 until no change in the feature map are observed.
The learning rate in step3 should be time varying. This requirement can be satisfied by choosing an exponential decay for $\eta(t)$.

$$\eta(t) = \eta oexp\left(-\frac{t}{\tau 1}\right), t = 0,1,2 \ldots \ldots \ldots, \ldots \ldots \ldots \ldots . (3)$$

Step 5 the output of SOM neural network precedes the input of RBF model. The hidden layer of input of RBF is Radius of SOM winner vector input. And apply ACP algorithm for adjustment of weight of RBF model.
Step a estimate the out of hidden layer

$$Hj = \frac{e^{-\|x-cj\|^2}}{2\sigma^2_{j}} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4)$$

$j=1,2,\ldots\ldots\ldots\ldots\ldots\ldots,n\hbar$

Stepb estimation of output layer

$$Yi = \sum_{i=1}^{n\hbar} wij\hbar i, j = 1,2, \ldots \ldots \ldots \ldots \ldots \ldots . n \ldots \ldots \ldots \ldots \ldots \ldots \ldots (5)$$

Stepc
Estimate the error

$$ej = t_j - y_{j,j=1,2\ldots\ldots\ldots\ldots n\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)}$$

Step d weight adjustment

$$w_{ji\,(k+1)=w_{ji\,(k)+\Delta w_{ij\,(k+1)}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(7)}}$$

$$\Delta w_{ij\,(k+1)=\partial.ej.f+\alpha.\Delta wji\,(k)}\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots(8)$$

I=1,2,……..nh;j=1,2,…….no;
Step e minimized the value of RMSE if not then got step 5

$$RMSE = \frac{1}{n}\sqrt{\sum_{i=1}^{n}\sum_{j=1}^{m}(tij - yij)^2} \ldots\ldots\ldots\ldots (9)$$

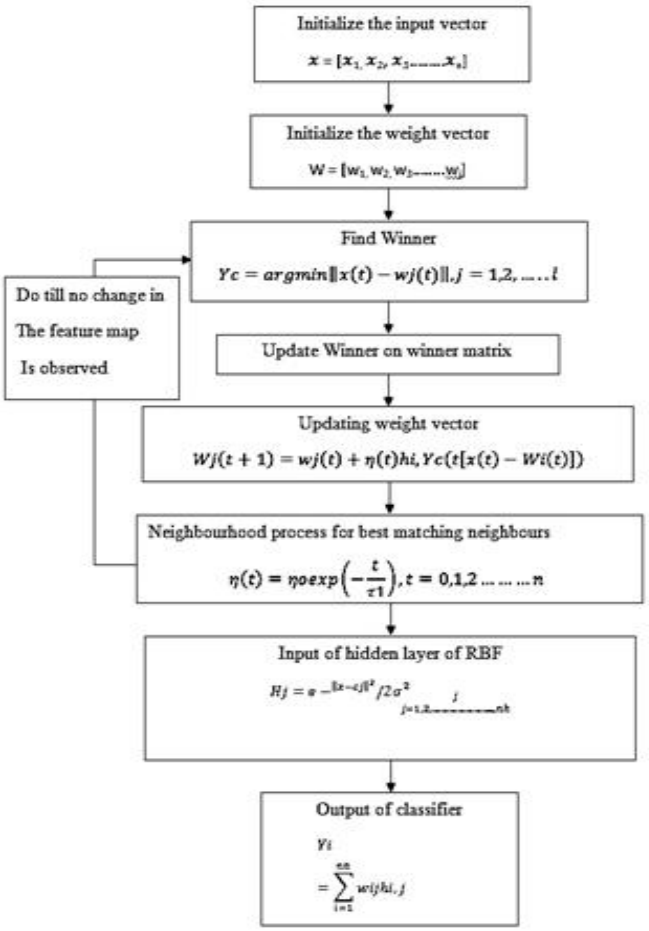

Figure 3 process of execution step formulation of SOM and RBF neural network model as hybrid compression.

IV. Experimental Result Analysis

In this section discuss the simulation and result analysis of image compression method. Here discuss two image compression algorithms one SOM and proposed algorithm.alltwo-algorithm implemented in MATLAB software [19,20]. The MATLAB software is well known recognition tools for image processing. It gives the basic and fundamental image processing tools.For the validation of proposed algorithm of image compression used some standard image such as Leena, Barbara, cameraman and some other image. This image resolution size is 512* 512. These entire images obtained from Google image database.

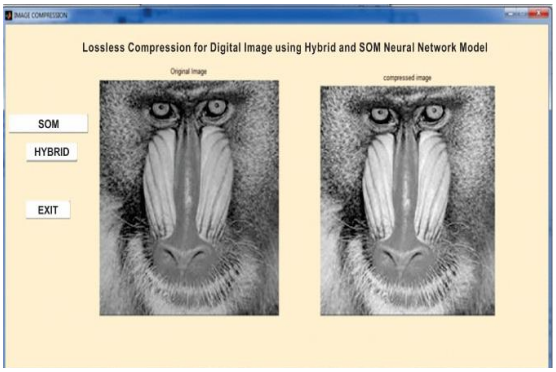

Figure 4: Show that the implementation window of Lossless Compression for Digital Image using HYBRID and SOM Neural Network Model, for Baballon2 Original and Compressed Image using SOM Methods.

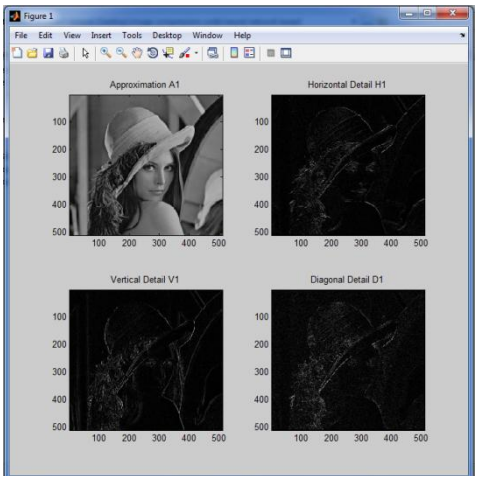

Figure 5: Show that the implementation window of Lossless Compression for Digital Image using HYBRID and SOM Neural Network Model, for Leena Image using HYBRID Methods.

Comparative Result Analysis

Table 1: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ratio using SOM and HYBRID method for Cameraman.jpeg image.

Method Name	PSNR	Compression Rate	Compression Ratio
SOM	26	0.484	12
HYBRID	27.92	0.432	15

Table 2: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ratio using SOM and HYBRID method for Baballon2.jpeg image.

Method Name	PSNR	Compression Rate	Compression Ratio
SOM	21.13	0.568	9.7
HYBRID	22.69	0.536	12.7

Table 3: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ratio using SOM and HYBRID method for Leena.jpeg image.

Method Name	PSNR	Compression Rate	Compression Ratio
SOM	21.13	83	0.15
HYBRID	22.69	89	0.13

Table 4: Shows that the PSNR, Compression Rate in bits/pixel and Compression Ratio using SOM and HYBRID method for Barbara2.jpeg image.

Method Name	PSNR	Compression Rate	Compression Ratio
SOM	20	0.63	9.25
HYBRID	21	0.56	12.08

Comparative Result Graphs

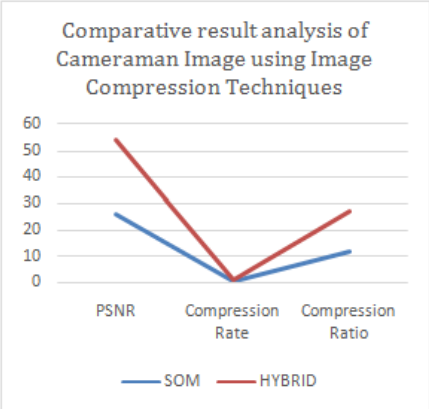

Figure 6: The above figure Show the result analysis on the basis of comparative result analysis study of using Cameraman image with include the performance parameter is PSNR, Compression Rate and Compression Ratio value with applied the method such as SOM and Hybrid Method. And here our Hybrid method result shows the better result than existing methods.

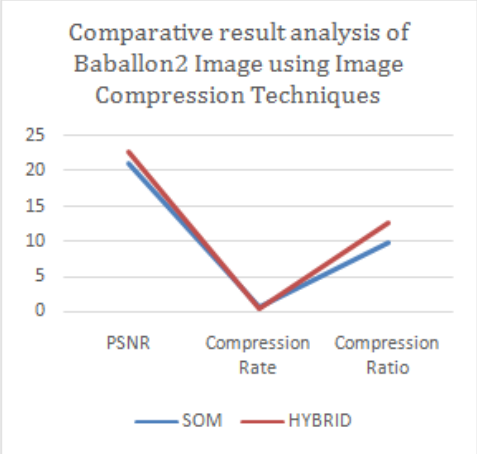

Figure 7: The above figure Show the result analysis on the basis of comparative result analysis study of using Baballon2 image with include the performance parameter is PSNR, Compression Rate and Compression Ratio value with applied the method such as SOM and Hybrid Method Method. And here our Hybrid method result shows the better result than existing methods.

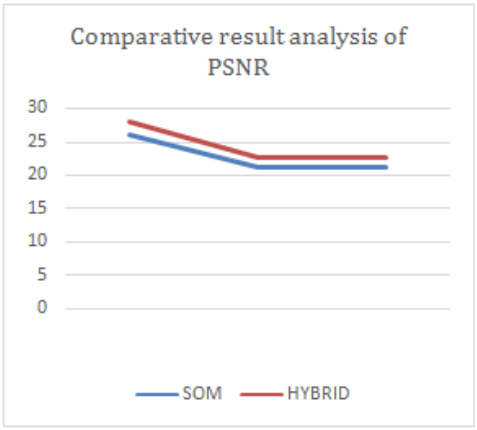

Figure 8: The above figure Show the result analysis on the basis of comparative result analysis study of using Cameraman image, Baballon2 image, Leena image and Barbara image with include the performance parameter is PSNR value with applied the method such SOM and Hybrid MethodMethod. And here our Hybrid method result shows the better result than existing methods.

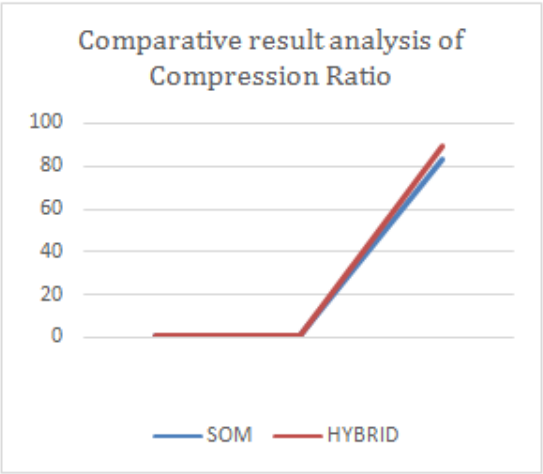

Figure 9: The above figure Show the result analysis on the basis of comparative result analysis study of using Cameraman image, Baballon2 image, Leena image and Barbara image with include the performance parameter is Compression Ratio value with applied the method such as SOM and Hybrid MethodMethod. And here our Hybrid method result shows the better result than existing methods.

V. Conclusion and Future Work

In this paper proposed the hybrid model of image compression. The hybrid model of image compression based on SOM neural network model and RBF neural network model, for the processing of image data used FIC transform function. The FIC transform function gives the similar block of non-overlapping coefficient for the processing of compression. The transform coefficient converted into vector and passes through hybrid model and HCC matrix. The hybrid model creates the similarly and non-similar group of cluster for the processing of compression and this group value passes through head coder matrix and finally image is compressed. The performance of compression technique is better instead of SOM model. The quality of compressed image is still remaining. In future used another model of neural network and increase the speed of image compression technique.

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