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Result Analysis of Proposed Image Enhancement Algorithm Based on a Self Organizing Map Network and Wavelet Transform

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Abstract

Removing and reducing noise and improving the quality of image is very active research area in image processing. Various applications require various kinds of images as genesis of information for various works. Whenever an image is converted degradation occurs at the output. The output image processed through image enhancement for the removal of degradation. The main aim of Image enhancement is processing an image so the output result while be more suitable than the input image for specific task. Wavelet transforms have become one of the most important and powerful tool of signal representation. It has been used in image processing, enhancement, data compression, and signal processing. A processing of data through wavelet is very efficient in process of neural network. This paper is written for the discussion of the results which are obtained for proposed algorithm for image enhancement based on cascading of self organizing map network and wavelet transform which is compared to existing technique like histogram equalization, and multi point histogram equalization technique of image enhancement. The Self organizing map network is unsupervised training mechanisms of pattern, due to this reason the processing of network is very fast and efficient as compared to another artificial neural network technique. And the combination of wavelet and cascaded SOM network has a great advantage over conventional method such as histogram equalisation and multi-point histogram equalisation of image enhancement. Our experimental result shows that our proposed work performances better than the conventional method of image enhancement.

Keywords

Image Enhancement, Wavelet, Artificial Neural Network, PSNR, AMBE

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1. Introduction

Image enhancement technique is the universal way of enhancing the quality of the image [2].Objective of image enhancement technique is to change the attributes of the image to improve its standard from the original [1]. There are n number of image enhancement techniques have been introduced in both the domain of image enhancement technique i.e. Special domain and transfer domain. In special domain the intensity value are modified where as in transfer domain the Coefficient of transfer domains are modified [2].There are many method used for image enhancement without spoiling the original image. There are various image enhancing techniques are present in market which are removing noise, blurring, increasing contrast & increasing the details properties .[5] The real image might have areas of very high and very near to the ground intensity which facade details are unhide by an adaptive enhancement algorithm. Adaptive algorithms correct their operation based on the image information (pixels) which is processed. In this scenario the sharpness (amount of blur removal), mean intensity, and contrast could be adjusted based on the pixel intensity statistics in various areas of the image. A very popular technique for contrast enhancement of images is Histogram Equalization (HE), which is simple and has good performance compared to nearly all types of images [9].Histogram Equalization is one of the most popular, computationally fast and simple to implement techniques for contrast enhancement of digital images. The histogram of a discrete gray-level image represents the frequency of occurrence of all gray-levels in the image. An image histogram is an estimation of the probability distribution of discrete gray-level which provides a graphical representation of the total distribution of the gray values in a digital image. The re-assignment of gray levels in the image can be performed with the Histogram Equalization techniques in order to uniformly distribute intensities of pixels in output image. It is a process of flattening the histogram and using cumulative density function of image, over the complete range the dynamic range of the gray-levels is stretched. On the other hand this method tends to suffer from brightness saturation and hence it is never used in real applications such as TV.

The main applications of HE are found in Medical Image Processing and Radar Image Processing [3]. Histogram Equalization performs its operation by remapping the intensity levels of the image based on the probability distribution of the input intensities. Various researches have been performed on Histogram Equalization, and many other methods have already been proposed such as multi point histogram equalization [9]. The techniques are categorized into 2 main categories, global and local Histogram Equalizations. The Global Histogram Equalization (GHE) uses the information provided by histogram of the input image for its transformation purpose. Though this worldwide approach is appropriate for the overall enhancement of image, as it fail to adapt local brightness-features of the inserted image and shifts the mean intensity to the middle intensity level, apart from the input mean intensity [10]. Thus it appears to be unsuitable for consumer electronic goods. Local HE (LHE) can remove the local brightness problem; however the overlapping sliding mask mechanism makes the LHE computationally expensive. With the technical advancements in processing power, the speed is not a problem. The Local Histogram Equalization still faces trouble with amplified noise and an unnatural output due to over-enhancement. Other approach is to apply a partially- overlapped or non-overlapped block based Histogram Equalization. De-composition of the input image is conversion into layers where these layers are separated by horizontal, vertical & diagonals in the wavelet transform technique . The parameters of enhanced of noised image quality are decided by soft thresholding. The Donoho & The John Stone firstly developed wavelet thresholding concept which removes noise from image by removing wavelet coefficient that are too noise and preserving or shirking the coefficient that contains important image signal. Image enhancement is majorly dependent on the standard of thresh holding parameters, due to this various thresh holding method have emerged. Wavelet transform is a multi resolution representation of signals of image. The artificial neural network abbreviated as ANN have an important role in the process of image enhancement as it have the nature of preserving brightness & contrast of the image inputted. The ANN by nature is variant & adaptive by this it preserves the initial values of the image pixel in it & set the desire targeted values for enhancing image quality. Single layer & multi layer both are used in ANN for image enhancement likewise used in ART ANN for binary image enhancement [15]. Feed forwarded artificial neural network using shunting mechanism are used for implementation of Morphological image operations whereas switch action are performed by neurons. As sake of enhancement of digitalized image in frequency domain the SOM ANN is used in the proposed work. The rest of paper is organized as described. In Section II proposed method, in section III experimental Result Analysis Followed by a conclusion in Section IV.

2. The Proposed Method for Image Enhancement

The present section is about the discussion on proposed image enhancement technique which is consisting of two stages of ANN model which is Kohonen's self organizing map (SOM) i.e. we cascaded the SOM network. Wavelet transform function is very important part of our method as it extracts image features from the image. Clustering mechanism is performed by SOM where it project N-dimensional features from the wavelet transform into an M-dimensional feature space. The resulting vectors are fed into an SOM that categorizes them onto one of the relearned noise classes. By cascading of neural networks in our proposed method it is a good ideal model which reduces complexity of enhancement process of image. Mapping of features are done from each frame of the word to the SOM output to form a trajectory of winner nodes for a given word. The SOM learns this trajectory for each enhancement scheme is comprised of a hierarchical organization of SOM and SOM. SOM receives inputs from the Wavelet transform function bank and maps onto an M-dimensional space where M is the dimensionality of the SOM output node distribution. The transformed feature vectors are fed into the SOM, which classifies them. We call the feature space generated from the Wavelet transform function output as primary feature space and M-dimensional feature space from SOM output as secondary feature space. The vectors from the secondary feature space are called secondary feature vectors. The concept behind the use of SOM as an intermediate stage is that it can perform and enhanced it. Topology preserving feature mapping from its input space to output space, and these mapped features, which are of reduced dimension, can represent the necessary information in the input features. Thus, the training and enhancement of the upper stage (SOM) can be done in a reduced dimension compared to the higher dimension of the primary feature space.

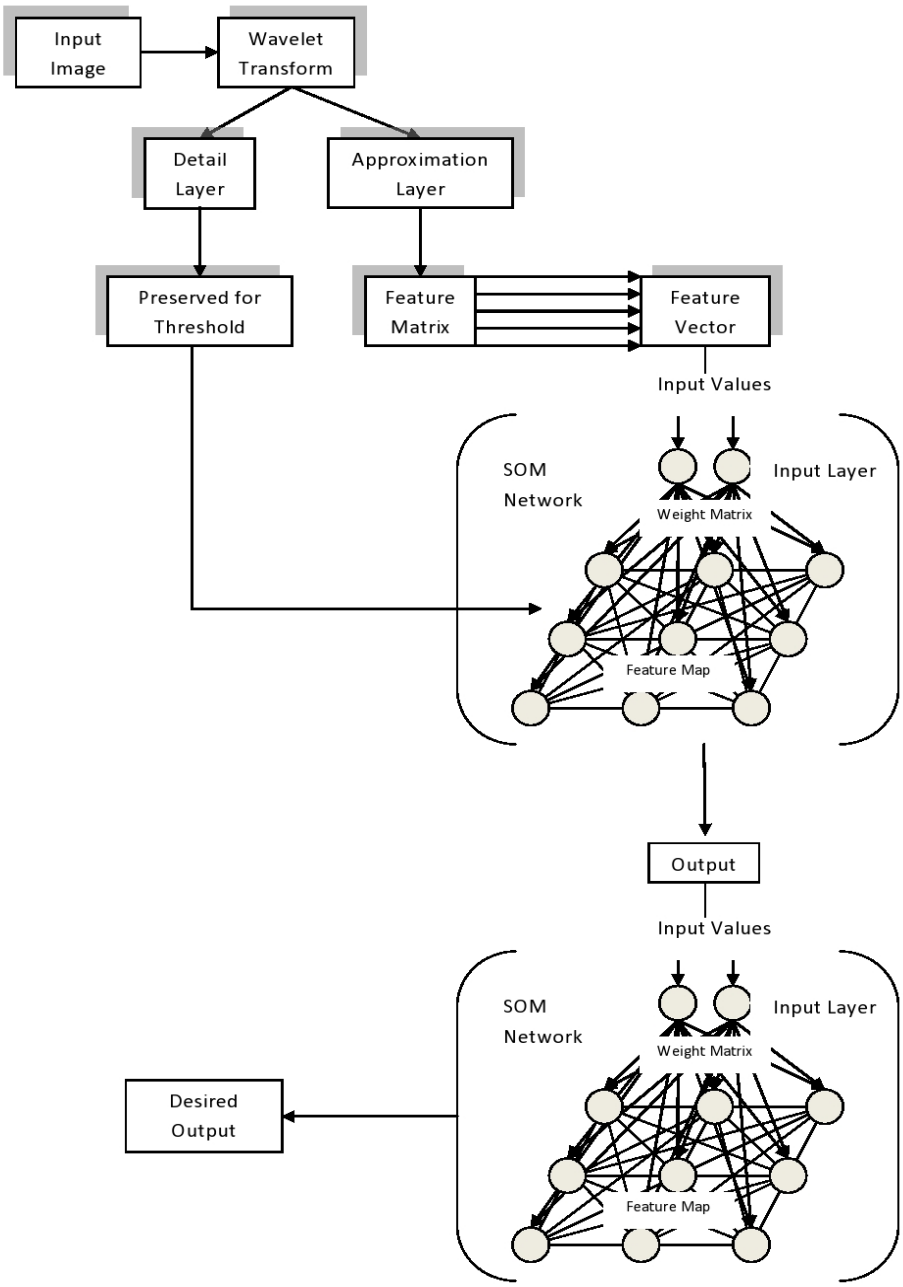

Figure 1: The Process Block Diagram of Cascaded SOM Network Having Input From Wavelet Transform.

Proposed algorithm for processing of cascaded SOM network

Step1. Initially input image passes through wavelet transform function and decomposed into two layers approximate and details layer. The part of detail layer work as threshold value for compression of target data.

Step2. The approximate layer of image is converted into horizontal, vertical, and diagonal into the feature vector.

Step3. After conversion of feature vector image data passes through self organizing map network.
Step4. In phase of feature mapping in feature space of SOM network create a fixed cluster according to threshold of details of image part.
Step5. Here are the steps shown for the processing of SOM network [12].

1) Initialize each node's weights.
2) In SOM the input random vectors are chosen the training data.
3) Traverse each node to calculate the BMU (Best Matching Unit).
4) The radius of the neighbourhood around the BMU is calculated. The size of the neighbourhood decreases with each iteration.
5) Each node in the BMU's neighbourhood has its weights adjusted to become more like the BMU Nodes closest to the BMU are altered more than the nodes furthest away in the neighbourhood.
6) Repeat from step 5.2 to 5.5 for number of enough iteration until focalize.
7) The concept of the Euclidean distance between Node weights are W1, W2, …….Wn and the input vector's values are V1, V2, … , Vn is used for the calculation of The Best Matching Unit.
    1) Step 5.7 gives a good calculation of how common the two sets of data are to each other among the provided data set.
8) The value adjusted theta is depending on the distance from Best Matching Unit. Updated weight of the node is calculated as the old weight with the addition of a fraction L value which is the the difference between the old weight and the input vector.
9) The rate of learning L, is function of exponential decay.
    1) The step 5.9 gives confidence that the Self Organizing Map will focalize.
10) The Time Step is represented by t where on the other hand he lambda represents a time constant.

Step6. After processing of SOM network out data of image is also passes through SOM two stage network.
Step7. Finally gets enhanced image and calculate the value of PSNR and AMBE.

3. Experimental Result Analysis

The performance calculation of image enhancement technique already existing and the proposed cascaded model the MATLAB software package is used. And some standard images are used for experimental process. Calculation of the performance is calculated by the Peak Signal to Noise Ratio (PSNR), and by Absolute Mean Brightness Error (AMBE) values these are standard parameters for the result analysis. For the Performance evaluation of proposed cascaded SOM method for some images like Lena, Family, and Baby, The images used are gray scale images of size of the image are 512 X 512 pixels. Proposed ccascaded SOM is a neural network based method for image enhancement.

The Figure numbered 2 shows the input image of a Baby and its histogram map of given image. Then in figure number 3 shows that enhanced image by Cascaded SOM method and equalized histogram map with PSNR value 36.93 and AMBE IS 38.61. After that in Table number 1 shows that value of PSNR, AMBE on the basis of method HE, MHE and SOM for the image BABY, FAMILY and LENA. After these we did a comparative study of PSNR and AMBE values for the image of baby on the bases of histogram equalisation, multipoint histogram equalisation and our proposed method showed in graph number 1.

As per our experimental result analysis we came to know that our proposed model is working better as compare to the existing model like histogram equalisation, multi point histogram equalization models. The result values of proposed model for PSNR are going higher as compared to other and the value of AMBE are going down, so as the virtue of these result shows that the proposed technique is working better than existing techniques enhancement of image.

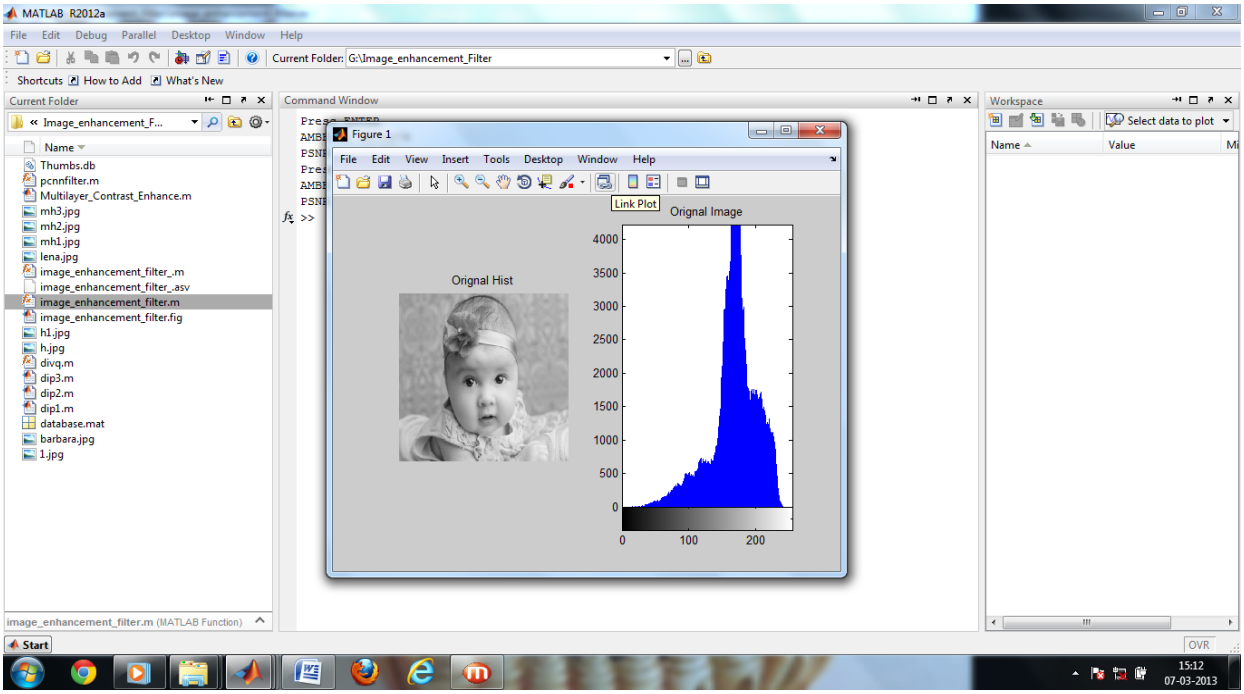

Figure 2: shows the input image of a Baby and its histogram map of given image.

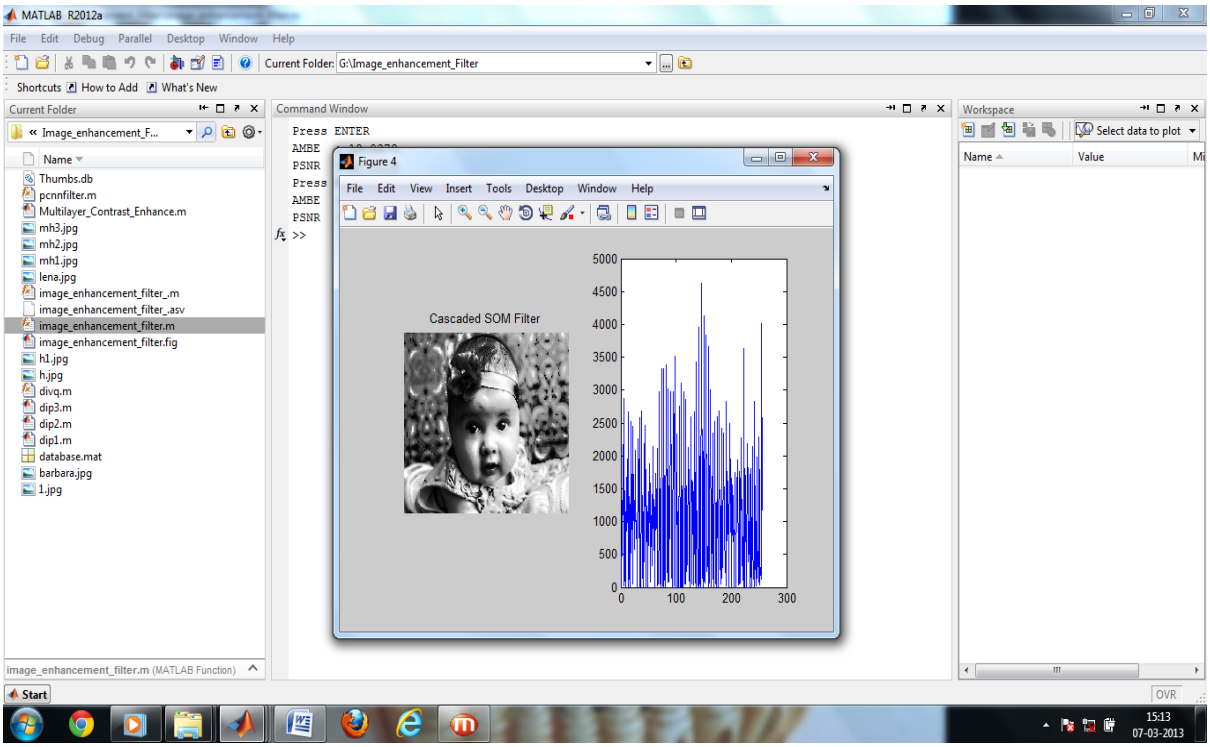

Figure 3: shows that enhanced image by Cascaded SOM method and equalized histogram map with PSNR value 36.93 and AMBE IS 38.61.

Table 1: shows that value of PSNR, AMBE on the basis of method HE, MHE and SOM for the image BABY, FAMILY and LENA.

IMAGE	PSNR(HE)	PSNR(MHE)	PSNR(SOM)	AMBE(HE)	AMBE(MHE)	AMBE(SOM)
Baby	28.99	32.43	36.93	101.02	97.56	38.61
Family	15.65	17.50	36.13	54.53	52.66	38.33
Lena	12.10	10.82	33.02	36.42	37.71	32.07

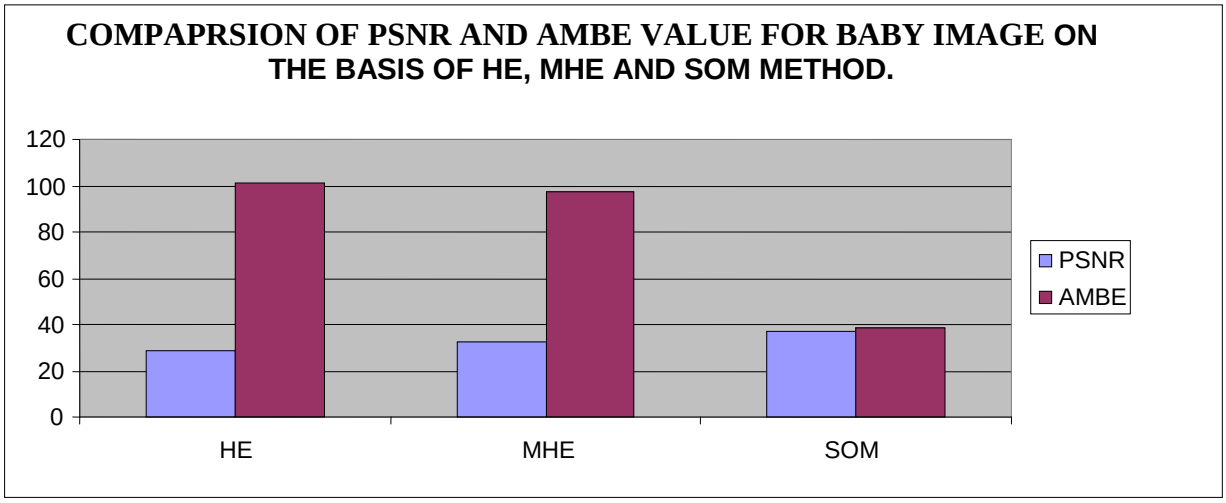

Figure 4: Graph 1 shows that comparative analysis of BABY image for three image enhancement method HE, MHE and SOM.

4. Conclusion and Future Work

The image enhancement is versatile field of research using ANN. The application of image in different field such as medical diagnosis, satellite image and user application are needed denosing and enhancement technique of image. The conventional technique such as histogram equalization and multipoint histogram equalization not perform up to mark. Now in this dissertation we proposed a cascading technique for image enhancement, cascading of neural network model play a great role for enhancement of image. In this paper we proposed cascading model of neural network, self organizing map network (SOM).The cascaded model of SOM network performs better in compression of H.E and M.H.E method of image enhancement. The increased performance of cascade model set the value of transform as threshold and process of approximate value for filtration and increases the value of PSNR and enhanced the quality of image. The complexity of this model is increase due to regression property of SOM network.

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