Comparability of Conventional Network and Neural Network Techniques for Image Enhancement Methods

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----------ABSTRACT----------

Image enhancement improves the quality (clarity) of images for human viewing. Neural Networks have been developed rapidly during the recent few years and it is extensively applied for the enhancement of the digital image.

The primary purpose of this study is to propose a comparison between conventional network and the Neural Network. The evaluation criterion is based upon edge detection, face detection

For this proposed comparison, the evaluation criteria parameters are implements and analyzes for both neural and conventional network.

Experiments on images are implemented to confirm the validity of the proposed analysis. One of the purpose of the study was to identify the main factor affecting the image and result are obtained were validated with existing techniques. This paper focuses on two popular features of image enhancement that are face detection and edge detection.

The number of experiments is done on the number of images which shows that in the edge detection of image used the counting of white pixels which are more than the counting of white pixels in conventional networks. The face detection method counts the single face and multiple faces in the image.

Keywords: Conventional networks, edge Detection, Face detection, Neural Networks.

1. Introduction:

The objective of this paper is to analyze the applicability of neural networks as well as conventional networks in image enhancement. The preliminary information about neural network and conventional network is discussed [1,2].Image enhancement is the process of improving the quality of digital image. The commonly used enhancement techniques are contrast enhancement, histogram equalization, edge sharpening, variety of filters and so on. Image enhancement improves the quality (clarity) of images for human viewing. This method is based on the three features of image which are to be enhanced i.e., auto image enhancement, face detection, edge detection. [3]

2. Conventional image enhancement:

Image enhancement is done by two methods in conventional networks i.e., basic gray level transformations and histogram methods.

2.1. Basic gray level transformations [11]: - It is the process of transforming an input image of some format to an output image comprised of gray scale data. Input sources range from images taken in the visual spectrum (e.g. photographs) to invisible spectrum (e.g. x-rays, infrared). Gray-scale images represent data per element in a shade of gray that ranges in intensity from zero (being black) to a maximum (being white) with various shades in between. For example, an 8-bit gray scale will range from 0 to 255, providing 256 different possible levels of brightness. An image processing system that looks at every input pixels gray level and generates a corresponding output gray level according to a fixed gray level map is referred to as a basic gray level transformation.

2.2 Histogram Modification [12]:- A histogram is a statistical graph that allows the intensity distribution of the pixels of an image, i.e. the number of pixels for each luminous intensity, to be represented. By convention, a histogram represents the intensity level using X-coordinates going from the darkest (on the left) to lightest (on the right). The modification of a histogram is usually represented on a curve (called a *tonal curve*) indicating the total modification of the image components with the initial values on the X-axis and the values after the modification on the Y-axis. The tonal curve corresponds to a transfer function defined by a translation table called a *look up table*, which is written *LUT*.

3. Neural image enhancement:
Neural network is a powerful data-modeling tool that is able to capture and represent complex input/output relationships. The motivation for the development of neural network technology stemmed from the desire to develop an artificial system that could perform "intelligent" tasks similar to those performed by the human brain. [8]
Neural networks resemble the human brain in the following two ways:

- A neural network acquires knowledge through learning.
- A neural network's knowledge is stored within inter-neuron connection strengths known as synaptic weights

4. Edge detection in Conventional Network:
The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the image. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness. The canny edge detector (including its variations) is still a state-of-the-art edge detector. Unless the preconditions are particularly suitable, it is hard to find an edge detector that performs significantly better than the Canny edge detector [6].

Canny's aim was to discover the optimal edge detection algorithm. In this situation, an "optimal" edge detector means:

- Good detection – the algorithm should mark as many real edges in the image as possible.
- Good localization – edges marked should be as close as possible to the edge in the real image.
- Minimal response – a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

4.1 Edge Detection in Neural Network: Edges are characterized by sharp transition in grey levels generally. They are important in computer image processing. Many edge detection methods are based on the idea to find the large difference area of grey level. Edge detection is to locate the positions where changes of image grey values are large.

Back propagation method was used on update process of parameters.

- Back propagation (BP) is the most used method in literature.
- BP's method is based on reducing parameters with a cost function on time.

The back-propagation algorithm uses the gradient of the performance function to determine how to adjust the weights to minimize errors that affect performance. The activation function of each node uses a sigmoid function,
$f(x) = 1/(1+e^{-x})$ Sigmoid function generates values between (0, 1), so values are round off normalized before input the network and reduced between (0, 1).

5. Face Detection in Conventional Networks:
Face detection is used in biometrics, often as a part of (or together with) a facial recognition system. It is also used in video surveillance, human computer interface and image database management. Some recent digital cameras use face detection for auto focus. Also, face detection is useful for selecting regions of interest in photo slide shows.

The input image is passed to the system. The input image consists of a full image and other properties of image, the desired output of this image shows that whether the image contains the faces or not. To get this desired output input image is passed to the system for preprocessing of the image in which the unwanted noise, blurring, lighting of image is removed. After this preprocessing the image is passed to the classifier which decides whether the image belongs to the face or non-face category and this procedure is done during the training period and produces the output.

5.1 Face detection in Neural Networks: In neural network based face detection approach, the neural network examines an incremental small window of an image to decide if there is a face contained in each window. To decrease the amount of time needed for detection, the algorithm is enhanced by processing the image before it is fed to the network. These results have even better performance as probability of error is considerably reduced.

The operation of the face detection system can be broken down into three main areas:

1. Initialization (design and creation of a neural network)
2. Training (choice of training data, parameters, and training)
3. Classification (scanning images to locate faces)

A feed forward neural network is created which is trained using back propagation. When a new image is presented to the network, the image is rescaled and divided into windows which are individually presented to the network for classification. Windows thought to contain a face are outlined with a black bounding box and on completion a copy of the image is displayed, indicating the locations of any faces detected.

6. Compare Results: The experimentation was done on the original images, by reading the original image and displaying it.

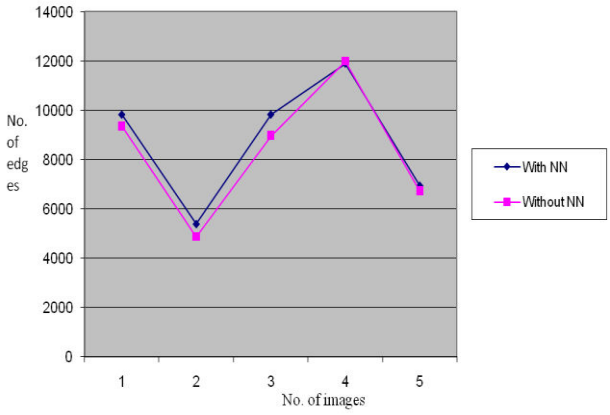
6.1 Edge Detection: For edge detection technique Canny method is used in which it uses the Gaussian filters and the threshold, for detecting the edges of the image.

In table 1 the edge detection is shown in which the no. of white pixels is calculated. In this the neural network shows the no. of white pixels more than the conventional network. It shows that the neural network detects the more edges than the conventional network. So, it will show that the neural network count more edges comparatively than the conventional method.

Image No.	Without NN	With NN
1	9354	9834
2	4875	5398
3	8975	9837
4	11987	11900
5	6734	6954

Table 1. Counting no of edges

In the graph the blue line shows the no. of white pixels in neural network and pink line shows the no. of pixels in conventional method. This graph shows the no. of white pixels is counted more than the conventional method.



Graph 1. Edge detection Graph

6.2 Face Detection: Training of neural network is done in which first it creates the database, and then initializes the network, then trains the network and at last test on images. The training of neural network is done by snntraintool.

For the analysis of neural network based face detection the different images are used and they are analyzed with the variation in no. of epoch during the training. This give the different result so that one can optimize the result as well as measure the value of optimize no. of epoch for the accurate face detection, means detection of single face and multiple face.

For conventional method of face detection only one face is to be detected, hence for image (contain single face) give 100% results, but in multi faced image sometimes it does not give the correct result, it is shown in table 2.

No. of epoch		1	2	3	4	5
Image no.	No. of faces in image	Number of faces detected				
1	1	1	1	1	1	1
2	3	6	6	4	4	3
3	4	8	6	4	4	4
4	6	13	10	8	6	6
5	22	73	51	48	24	22

Table 2. Counting the no of faces in the image

7. Conclusion: Through this comparative study, it is seen that the neural method of image processing is better than the conventional method for image processing. The performance analysis of the results shows the higher accuracy in neural networks then the conventional networks.

8. Future Work: The future scope is to design the algorithm similar to the back propagation algorithm which may be used to train networks whose neurons may have discontinuous or non-differentiable activation functions. These new algorithms should also have the capability to speed up the convergence of Back-propagation algorithm. Modified forms of back propagation algorithm such as Quick BP, RPROP, SAR-PROP, and MGF-PROP can provide a great help.

1) Taking into consideration massively expensive parallel architecture required for hardware implementation of the algorithm, this problem can be overcome by using analog computation elements such as multipliers and adders.
2) Second solution to this problem is the use of fixed-point computation for limited precision architectures, where a look up table can be used.

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