# Performance Analysis Of Digital Watermarking Using Counter Propagation Neural Networks

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## Abstract

*Watermarking is a method in which an image or pattern is put on paper in the form of various shades of lightness/darkness especially when viewed by transmitted light. Digital watermarking where computer-aided information is used in the hiding information is one of the most popular forms of watermarking. Existing techniques based on spatial and frequency domain suffer from the problems of low Peak Signal to Noise Ratio (PSNR) of watermark and degradation in image quality. In earlier papers, the author proposed only the watermark was embedded and extracted through specific FCNN technique. In this paper, we propose Hopfield model and full counter propagation neural network (FCNN) techniques for two images as a cover image and one image in the form of text as watermark image to overcome the remedies such as peak signal to noise ratio (PSNR) of watermarked image and to check the quality of the image normal correlation(Ncor) is also calculated by using six parameters.*

**Keywords-FCNN,PSNR,Ncor**

## 1.INTRODUCTION

Watermarking is a method in which an image or pattern is put on paper in the form of various shades of lightness/darkness especially when viewed by transmitted light. There is various types of watermarking such as public watermarking, blind watermarking, semi-blind watermarking, private watermarking, non-blind watermarking, asymmetric watermarking and Digital watermarking. Digital Watermarking is a technology that hides information, for example a number or text, in digital media, such as images, video or audio. The information to be embedded in a signal is called a digital watermark.The embedding takes place by manipulating the content of the digital data, which means the information is not embedded in the frame around the data. The hiding process has to be such that the modifications of the media are imperceptible. For images this means that the modifications of the pixel values have to be invisible.The watermark must be either robust or fragile.Robust mean the capability of the watermark to resist manipulations of the media, such as lossy compression (where compressing data and then decompressing it retrieves data that may will be different from the original, but is close enough to be useful in some way), scaling, and cropping, just to enumerate some. Digital watermarks have been broadly and successfully deployed in billions of media objects across a wide range of applications such as Content protection for audio and video content, Document and image security, Locating content online, Rich media enhancement for mobile phones.

Neural Network referred to as an 'artificial' neural network (ANN), is defined as a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs. ANNs are processing devices (algorithms) that are loosely modelled after the neuronal structure of the mamalian cerebral cortex but on much smaller scales. A large ANN might have hundreds or thousands of processor units, whereas a mamalian brain has billions of neurons with a corresponding increase in magnitude of their overall interaction and emergent behaviour. Although ANN researchers are generally not concerned with whether their networks accurately resemble biological systems.The network is composed of a large number of highly interconnected processing elements (neurones) working in parallel to solve a specific problem. Neural networks learn by example. They cannot be programmed to perform a specific task. The examples must be selected carefully otherwise useful time is wasted or even worse the network might be functioning incorrectly. The disadvantage is that because the network finds out how to solve the problem by itself, its operation can be unpredictable.

Neural networks are typically organized in layers. Layers are made up of a number of interconnected 'nodes' which contain an 'activation function'.

Patterns are presented to the network via the 'input layer', which communicates to one or more 'hidden layers' where the actual processing is done via a system of weighted 'connections'. The hidden layers then link to an 'output layer' where the answer is output.

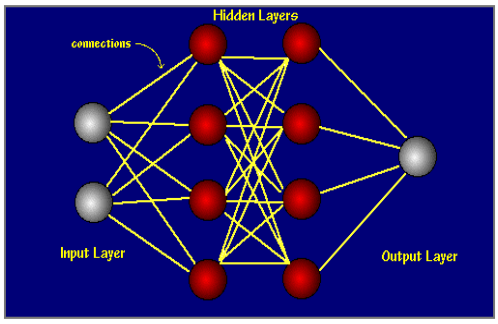


Fig 1: Architecture of a simple neural network

In this paper we proposed a Full counter propagation Neural network and Hopfield model for watermarking. Different from the traditional methods watermark is embedded in the synapses of FCNN rather than the cover image. Full counter propagation neural network helped to increase robustness and reduce imperceptibility problems to a great extent. Full counter propagation neural network reduced the distortion to a negligible level. FCNN works on the competitive learning. The competitive layer of the full counter propagation network chooses a winner that produce some or the other output watermark. The conventional Hopfield model is the most commonly used model for auto-association and optimization. Thereafter, starting from an arbitrary configuration, the memory will settle on exactly that stored image, which is nearest to the starting configuration in terms of Hamming distance. In this section we have discussed the basic digital watermarking technique to extract the embedded watermark with forward counter propagation neural network (FCNN) and Hopfield model for two input images as a cover image. In later section, we will discuss the literature survey with the techniques used to tackle the above discussed problem.



## 2. LITERATURE SURVEY

- Tripathi[5] et al. proposed digital watermarking scheme uses the properties of discrete cosine transform (DCT) and discrete wavelet transform (DWT) to achieve almost visible distortion in the watermarked image. These techniques used a unique method for spreading, embedding and extracting the watermark.
- Potdar[4] et al. did a survey on digital image watermarking techniques.This technique is based on different domains in which data is embedded. In watermarking techniques a visible and invisible watermark is embed in the multimedia object. The embedding process is guided by a security key.
- Yusof[7] et al. Proposed digital watermarking for digital images using wavelet transform. Wavelet transform decomposes an image into a set of band limited components which can be reassembled to reconstruct the original image without an error. Watermark is embedded into the band pass wavelet coefficients with large amplitude within the images by using quantization process.
- Wajid[6] et.al proposed robust and imperceptible image watermarking using full counter propagation neural network. There is always a trade off between robust and imperceptibility features of watermarking offered by various techniques full counter propagation neural network is used to train multiple gray or colour cover images' to produce desire watermark image.
- Oueslati[3] et.al proposed adaptive image watermarking scheme based on neural network to enhance medical data security confidentially. The watermark is inserted into middle frequency coefficients of the cover image blocked DCT based transform domain. In order to make the watermark stronger and less susceptible to different types of attacks.
- Meva[1] et.al proposed adoption of neural network approach in steganography and digital watermarking for covert communication and copyright protection. The word steganography means 'concealed writing' from the Greek words and stegano meaning

'covered or protected' and graphic meaning 'to write' and this technique is used to protect information and conceal secrets.

- Ramamurthy [2] et.al proposed effect of various attack on watermarked image. Watermarked images are affected by various attacks such as cropping, salt and pepper noise and rotation. These attacks destroy the inserted watermark so that copyright problem may arise. This can be reduced by properly inserting the watermark with effective algorithm.

## 3. TECHNIQUES USED

In this paper we use the two technique forward counter propagation neural network (FCNN) and Hopfield model to extract the embedded watermark and give the comparison of these two techniques based on peak signal to noise ratio (Psnr) and Normal correlation (Ncor) to check about the quality of a image. As shown in figure input image (two images as a input) of any size is first converted into 512*512. This is the cover image. This cover image is further converted into discrete cosine transform (DCT) block by block and the encoded bits are embedded into the mid band coefficient of block. Inverse discrete cosine transform (IDCT) of this embedded cover is given to the input of FCNN and Hopfieldmodel. PSNR and Ncor are obtained for six perameters for FCNN and Hopfield Model.comparison is done on the basis of PSNR and Ncor on the basis of these six parameters.

### 3.1 Full Counter Propagation Neural Network:

The full counter propagation neural network is a hybrid network. It consists of an outstar network and a competitive filter network. The hidden layer is a Kohonen network which categorizes the pattern that was input. The output layer is an outstar array which reproduces the correct output pattern for the category. Training is done in two stages. The hidden layer is first taught to categorize the patterns and the weights are then fixed for that layer. Then the output layer is trained. Each pattern that will be input needs a unique node in the hidden layer.

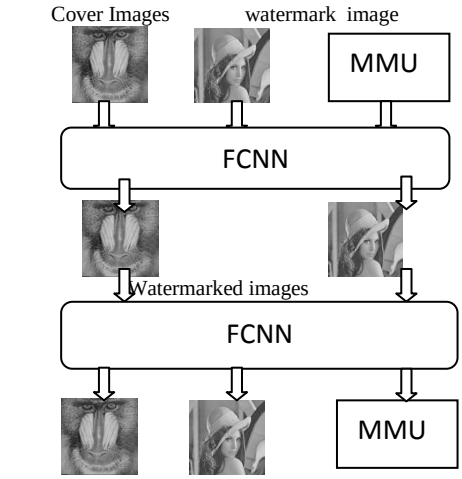


Fig.2 Schematic Block Diagram of FCNN Embedding and Extracting procedure

### 3.2 Hopfield Model:

Hopfield nets serve as content-addressable memory systems with binary threshold nodes. The Hopfield model accounts for associative memory through the incorporation of memory vectors. In associative memory for the Hopfield network, there are two types of operations: auto-association and hetero-association. Hopfield's network model utilizes the learning rule as Hebb's learning rule, which basically tried to show that learning occurs as a result of the strengthening of the weights by when activity is occurring. and it is related to other recurrent networks such as the Bidirectional Associative Memory.

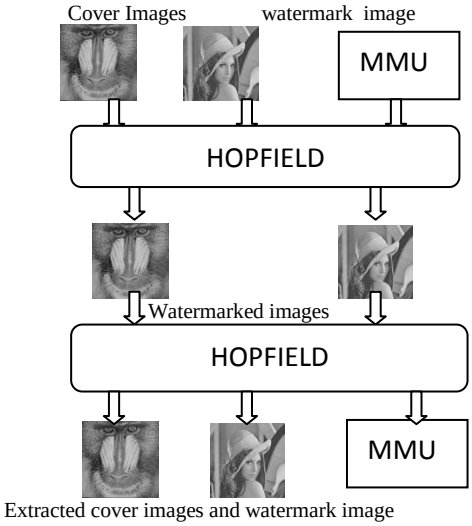


Fig.3 Schematic Block Diagram of Hopfield Embedding and Extracting procedure

## 4. RESULTS

In order to show that the proposed paper has good performance for watermarking, two

model i.e. FCNN and Hopfield model (two images as a input as cover image and one text image as watermark image) are proposed to calculate peak signal to noise ratio (PSNR) and Normalized correlation (Ncor) for six parameters as shown in table.

TABLE : 1

| S. No | Parameters | Baboon | |
|---|---|---|---|
| | | PSNR | |
| | | FCNN | HOPFIELD MODEL |
| 1 | Add. White Gaussian Noise | 51.6685 | 33.5555 |
| 2 | Gaussian Low pass filter | 48.7944 | 25.4505 |
| 3 | Compression | 43.457 | 43.4607 |
| 4 | Image cut | 43.4731 | 43.4693 |
| 5 | Rotate 10° | 43.463 | 43.4623 |
| 6 | Direct Detection of watermark | 46.0236 | 32.3705 |

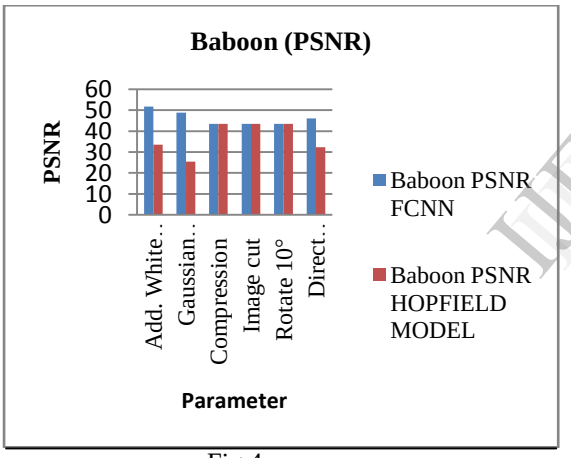


Fig.4

Table.2

| S. No | Parameters | Baboon | |
|---|---|---|---|
| | | Ncor | |
| | | FCNN | HOPFIELD MODEL |
| 1 | Add. White Gaussian Noise | 0.9998 | 0.9997 |
| 2 | Gaussian Low pass filter | 0.9933 | 0.9932 |
| 3 | Compression | 0.0045 | 0.0041 |
| 4 | Image cut | 0.0027 | 0.0031 |
| 5 | Rotate 10° | 0.0039 | 0.0039 |
| 6 | Direct Detection of watermark | 1 | 1 |

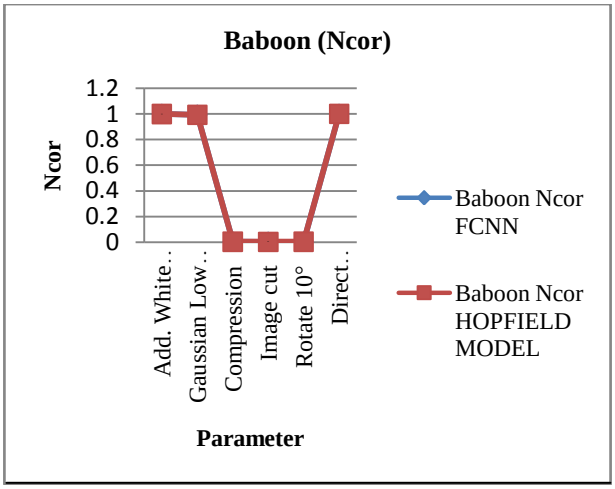


Fig.5

Table.3

| S. No | Parameters | Leena | |
|---|---|---|---|
| | | PSNR | |
| | | FCNN | HOPFIELD MODEL |
| 1 | Add. White Gaussian Noise | 50.2369 | 32.7601 |
| 2 | Gaussian Low pass filter | 43.7169 | 23.9393 |
| 3 | Compression | 43.4589 | 43.4587 |
| 4 | Image cut | 43.4675 | 43.4645 |
| 5 | Rotate 10° | 43.4610 | 43.4604 |
| 6 | Direct Detection of watermark | 44.4329 | 31.5751 |

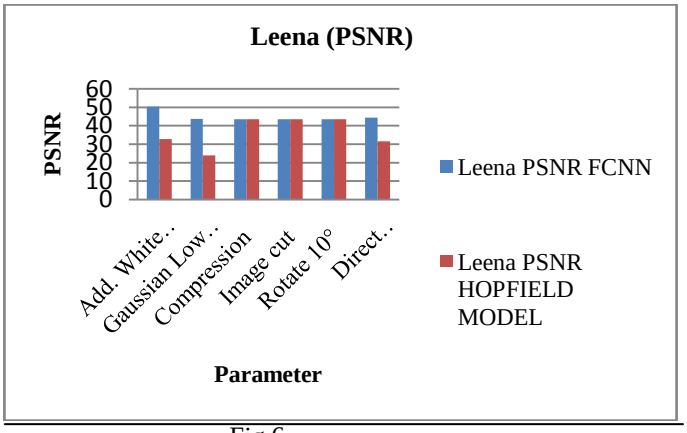


Fig.6

| S. No | Parameters | Leena | |
|---|---|---|---|
| | | Ncor | |
| | | FCNN | HOPFIELD MODEL |
| 1 | Add. White Gaussian Noise | 1 | 1 |
| 2 | Gaussian Low pass filter | 0.9963 | 0.9963 |
| 3 | Compression | 0.0036 | 0.0036 |
| 4 | Image cut | 0.0026 | 0.0030 |
| 5 | Rotate 10° | 0.0034 | 0.0034 |
| 6 | Direct Detection of watermark | 1 | 1 |

Table.4

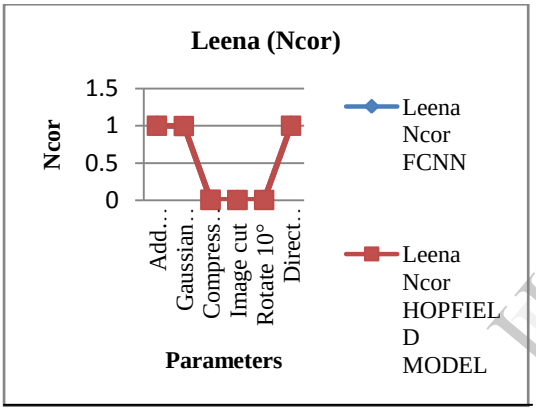


Fig.7

## 5. CONCLUSION AND FUTURE SCOPE

As shows in tables and graphs PSNR and Ncor is calculated for FCNN and Hopfield Model (two different images) for six different parameters. As observed Hopfield shows better result in case of peak signal to noise ratio in comparison with FCNN. In case of Normalized correlation both Hopfield Model and FCNN shows almost same result. It shows that there is no degradation in image quality means two cover images at the input and output correlate with each other. In future a new algorithm can be designed to embed and extract a watermark using neural network, where the neural network will be used in both the embedding process as well as the extraction process. The neural network used may be trained to detect the suitable place to embed the watermark based on Region of Interest (ROI). Once the watermark is embedded, the embedded area can be again detected from the watermarked signal using another trained neural network.

## 6. REFERENCES

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