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Analysis of Digital Watermarking using full Counter Propagation Neural Networks and Hopfield Model

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Abstract

Digital Watermarking offers techniques to hide watermarks into digital content to protect it from illegal copy or reproduction. Existing techniques based on spatial and frequency domain suffer from the problems of low Peak Signal to Noise Ratio (PSNR) of watermark and image quality degradation in varying degree. 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 to overcome the remedies such as peak signal to noise ratio (psnr) and to maintain the quality of the image. We also calculate the psnr and normal correlation by adding the white Gaussian noise.

Keywords: *FCNN, PSNR, ANN, NCOR*

1. INTRODUCTION

In this section, we discuss the introduction to digital watermarking which covers the Basic Principle of how the information is embedded in the digital media. This chapter also introduces the concept of counter propagation neural network and Hopfield model. Over the past several years, the ease of copying and distributing copyrighted multimedia such as video, audio, image and software over the internet has increased significantly. With the emergence of peer-to-peer file sharing systems, this problem has only become more critical. These systems allow each PC to act as a file server for the network, sharing illegal multimedia data. As a result, there is a strong need to protect the rights of the authors and there are several possible solutions. One such solution of this
problem is to use the digital watermarking technique. A digital watermark is a piece of
information which is embedded in the digital media and hidden in the digital content in such a way that it is inseparable from the data, this piece of information known as watermark. However, in any watermarking scheme the trade-off always exists

between the robustness of the watermarking algorithm to signal processing attacks and the transparency of the watermark. It is known that as the energy of the watermark is increased, the probability of full recovery of the watermark is also increased. However, by increasing the watermark energy, we increase the noise in the signal and thus make the watermark audible. Digital watermarking is just an adequate technology that tackles the security problems, which are not solvable by cryptography

Digital watermarking can be of two types:
(a) Visible watermarking and
(b) Invisible watermarking.
In visible watermarking, the information is visible in the image or video. The information may be a text or a logo which identifies the owner of the media. In invisible watermarking, information is added as digital data to audio, picture or video, but cannot be perceived. The hidden information can be detected to some extent. Digital watermarking on the other hand should be robust against attempts to remove the hidden data. A popular application of watermarking is proof of ownership. As mentioned before, based on the host signal in which the watermark is embedded, watermarking may be classified as:
1.1 Digital image Watermark- Both visible as well as invisible watermarking is applicable in images.
1.2 Digital video Watermark- A video sequence consists of many frames that can be taken as images. Hence, the process of watermarking in images can be extended to videos also.
1.3 Digital audio Watermark- Only invisible watermarking is possible.
1.4 3D Multimedia based Watermark.

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by
the biological nervous systems, such as the brain. It
is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems Neural Network is configured for pattern recognition or data classification, through a learning process. In biological systems, Learning involves adjustments to the synaptic connections that exist between the neurons. Neural networks process information in a similar way the human brain does. The network is composed of a large number of highly interconnected processing elements working in parallel to solve a specific problem

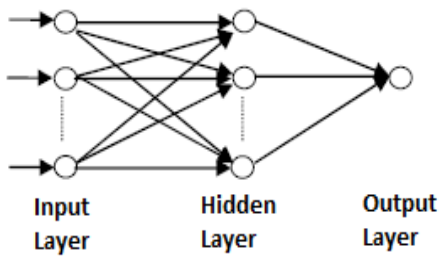

Figure 1: Neural Network

The earlier methods mentioned above require complex embedding and corresponding extraction procedures. In this paper we proposed a specific full counter propagation neural network (FCNN) and Hopfield for watermarking. Different from the traditional methods, the 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. 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. In later section, we will discuss the literature survey with the techniques used to tackle the above discussed problem.

2. LITERATURE SURVEY

- Prof Ashish Bansal[1] et al. developed a technique based on Full Counter propagation Neural Network (FCNN) use the concept of embedding the watermark into synapses of neural net rather than the cover image to improve PSNR of watermark and to prevent image quality degradation.
- Chuan-Yu[2] et al. developed a technique based on Full Counter propagation Neural Network (FCNN).In this method the multiple cover images and the watermark are embedded in the synapses of FCNN simultaneously instead of cover images.
- Zhang Zhi Ming[3] et al. developed a technique based on Radial Basis Function(RBF) Neural Networks to achieve maximum strength watermark.
- Fengsen Deng [4] et al. developed a novel technique for robust image watermarking in DCT Domain.
- Hsieh[5] et al. proposed a watermarking method based on the qualified significant Wavelet tree (QSWT) .In this method the embedding scheme take the relationships of DWT coefficients and spatial information into consideration.
- Hsu[6] et al. presented an image authentication technique by embedding digital watermark into image. In their approach; embed the watermarks with visually recognizable patterns into the images by selectively modifying the middle frequency parts of the image.
- Schyndel[7] et al. proposed two digital watermark techniques. The first technique based on manipulates the bit plane of LSB, while the second utilize linear addition of watermark to cover image
- J.-F. Delaigle[8] et al. presents a process able to mark digital pictures with an invisible and undetectable secret information called the watermark. This process is based on the complete copyright protection system.
- Jana Dittmann[9] et al. proposed "Theoretical framework for a practical evaluation and comparison of audio watermarking schemes in the triangle of robustness, transparency and capacity", In Transaction on Data Hiding and Multimedia Security.

- Tripathi Shikha[10] et al. proposed digital watermarking scheme uses the property of Discrete Cosine transform(DCT) and Discrete wavelet Transform(DWT) to achieve zero visible distortion in the watermarked images. It uses the method for spreading embedding extracting.

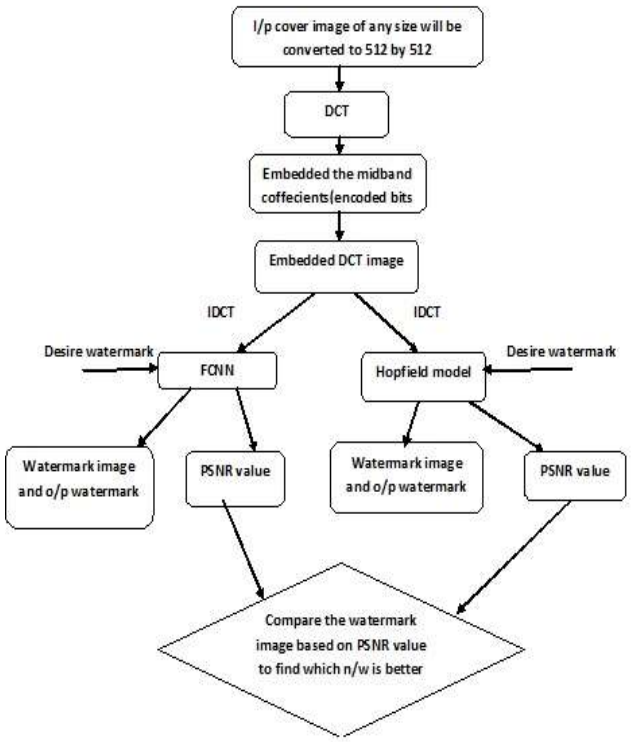

Figure 2: Flow Chart for Digital Water marking using FCNN and Hopfield Model

3 . TECHNIQUE USED

In this paper we use the two technique forward counter propagation neural network and Hopfield del to extract the embedded watermark and give the comparison of these two techniques based on peak signal to noise ratio (PSNR) and normal correlation to check about the degradation of image. As shown in figure input image 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 Hopfield model. Peak signal to noise ratio(PSNR),normalized

correlation(NCor) and extracted watermark is obtain at the output of **FCNN** and **Hopfield model**.

3.1 Full Counter Propagation Neural Network**:** Full counter propagation neural network (FCNN) is the first technique proposed for digital watermarking. Full counter propagation neural network is a supervised-learning network with capacity of bidirectional mapping. The proposed watermarking method integrate the embedding and extraction procedure into full counter propagation based neural network .FCNN could embedded multiple images simultaneously. FCNN designed to learn bidirectional mapping through the process of supervised learning.

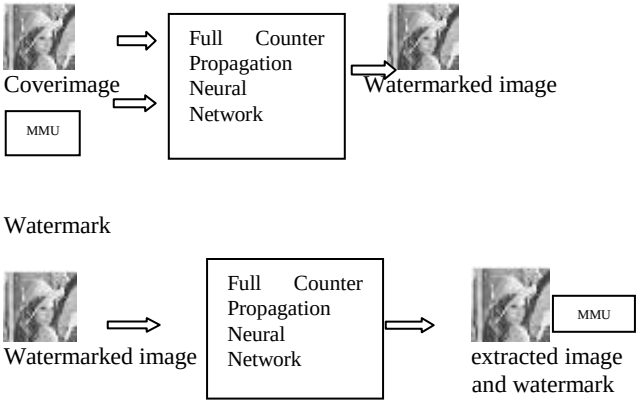

Figure 3: Schematic Block Diagram of FCNN
(a) Embedding Procedure (b) Extracting Procedure

3.2 Hopfield Model: The Hopfield neural network is a simple feedback neural network which is able to store the patterns in a manner rather similar to brain-the full pattern can be recovered if the network is presented with only partial information. Furthermore there is a degree of stability in the system if just a few of the connections between the nodes are served, the recalled pattern is not too badly corrupted and the network can respond with a best guess. Pattern storage is generally accomplished by a feedback network consisting of processing units with non linear bipolar output functions. The stable state of the network represents the stored patterns. Hopfield in 1982 proposed a fully connected neural network model of associative memory in which we can store information by distributing it among neurons and recall it from the neuron states dynamically relaxed. Hopfield used the Hebbian learing rule

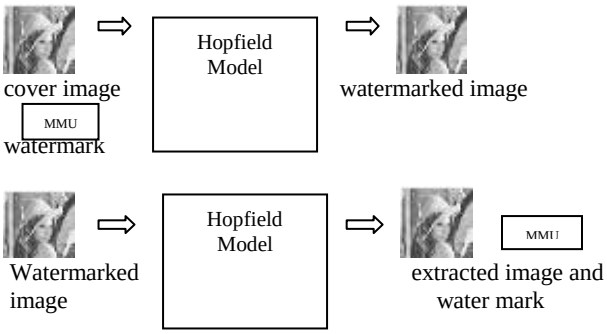

Figure 4: Schematic Block Diagram of Hopfield

4 . RESULTS

In order to show that the proposed paper has good performance for watermarking, two model i.e. FCNN and Hopfield model are proposed to calculate peak signal to noise ratio (PSNR) and normalised correlation (NCOR) as shown in table.

Table 1.

parameters	**FCNN**		**HOPFIELD MODEL**	
	Psnr	**Ncor**	**Psnr**	**Ncor**
Adding white Gaussian noise	50.2369	1.000	30.1226	0.9688
Using Gaussian low pass filter	43.7169	0.9963	19.9930	0.9732
Compressed image	43.4589	0.0036	43.4579	0.9734
Image cut	43.4675	0.0026	43.4673	0.8427
Rotate 10	43.4610	0.0034	43.4598	0.4934
Direct detection of watermark	44.4329	1.0000	26.8221	0.9734

In the above table it is clear that Peak signal to noise ratio (Psnr) is same for compressed image, image cut and rotation of image to 10^0 but the Normalized correlation (Ncor) is different for theses parameters and almost same for other three parameters. On other hand the Peak signal to nose ratio is different for adding white gaussian noise, using Gaussian low pass filter and direct detection of watermark.

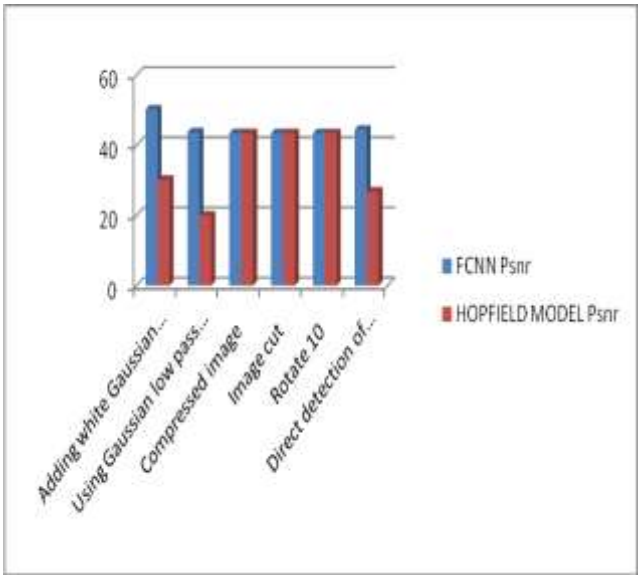

Figure 5: Graph showing comparison for Psnr between FCNN and Hopfield Model

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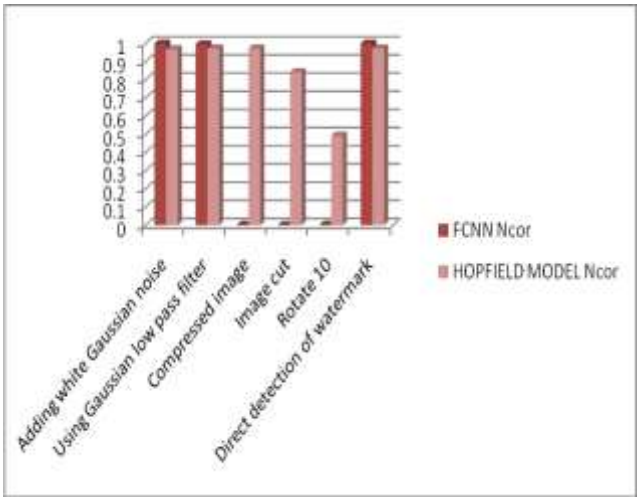

Figure 6 Graph showing comparison for Ncor between FCNN and Hopfield Model

5. CONCLUSION

In this paper a specific Full Counter Propagation Neural Network and Hopfield model are presented for digital water marking. In these techniques watermark is embedded in the cover image. The quality of watermarked image is same as that of cover image. But Hopfield model shows better results for Peak Signal to Noise Ratio in three parameters i.e. adding white Gaussian noise, by using Gaussian low pass filter, direct detection of water mark. This shows that Hopfield model can resist various attack better than FCNN.

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