Scholars Journal of Engineering and Technology

OPEN ACCESS

Abbreviated Key Title: Sch J Eng Tech
ISSN 2347-9523 (Print) | ISSN 2321-435X (Online)
Journal homepage: https://saspublishers.com

Indian Currency Recognition and Verification using Neural Networks

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DOI: 10.36347/sjet.2020.v08i12.006 | **Received:** 11.09.2020 | **Accepted:** 05.11.2020 | **Published:** 30.12.2020

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Abstract **Original Research Article**

The technological development in the era of image processing and machine vision has two faces. One face is to help the society by automation and the other side has serious implications on the society like cybercrimes e.g. web hacking, cracking, etc. one of the emerging crimes is preparing fake legal documents in now days. These documents have social values, like a degree certificate certifies the educational qualification of a person. The legal documents contain lots of symbols like kin grams, hologram, watermark etc. by which we can verify the authenticity of these documents. Digital watermarking emerged as a tool for protecting the multimedia data from copyright infringement. In this paper an attempt has been made to verify the legal document on the basis of watermark. In this work the correlation mapping with neural network is used for extracting the watermark to verify the legal documents. This technique gives elevated accuracy rate with fewer times to extract watermark. Verifying the currency has many applications in banks as they have to deal with counterfeit currency every day. Our system would be extremely useful for a person to check the authenticity of his currency note this method can be implemented also in additional applications like stamp verification, currency verification etc.

Keywords: Watermarking, Multilayered-Network, Certifying, Epochs.

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1. INTRODUCTION

With the increasing use of internet and effortless copying, tempering and distribution of digital data, copyright protection [1] for multimedia data has become an important issue. There are lots of symbols present on the printed document for their identification but in this work, watermark has been chosen for the verification. Basically, legal documents can be verified by two methods: first-line inspection methods and second-line inspection methods. First-Line Inspection Methods are Watermarks, Ultraviolet Fluorescence, and Intaglio Printing are further divided in Micro text & Holograms and Kin grams and second is Second-Line Inspection Methods Iso check / Isograms. Recent public literatures show that some researchers have tried to apply watermarking into printing system. In geometric transform. Pun [5] has devised a watermarking algorithm robust to printing and scanning. The Photo Check software developed in Alp Vision Company by Kutter [6] is mainly focused on authentication detection of passports. As a passport belongs to the owner with his photo, this belongs to a content-based watermarking technique. When the photo is changed, the image with the watermark is of course lost and this just requires that the watermark hidden in the owner's passport is robust to one cycle of print and scan. Considering the special characteristic of FFT on rotation, scaling and cropping, Lin [7, 8] has carried out the research on fragile watermarking rather early and obtained many useful conclusions on the distortion brought by print and scan. Re-searchers in China [9] began to hide some information in printing materials, using the function offered by Photoshop. All these are focused on the watermark robust to one cycle of print and scan.

2. Basic Concept

1. Since water mark making requires highly efficient technique and the water mark can be seen only by its shadow, the water mark can be effective key to certify the currency note.
2. In certifying the currency note, since normally using currency note is folded, sometimes noise occurred, it needs feedback learning of water mark of used currency note. The back propagation neural network is suitable to certify the water mark, because it can design many layers for many nodes network, that it is used to recognize the complicate pattern [3].

They consider correlation as the basis for finding matches of a sub- image w(x,y) of JxK within an image f(x,y) size MxN, we assume that J≤M and

K≤N. They prepare the template of each type of note then apply correlation on each stored note with on which we are testing. Zero value of correlation coefficient gives the location of the watermark [10].

3. Certifying

To certify the watermark, it is inputted to back-propagation neural network. Result of neural network is used to certify the currency note. First neural network must be trained by sending the ideal watermark to it. Size of input is sent to neural network about 4005 nodes.

4. Trainable Multilayered- network

BP method is given by eq(5.2) as [6]

$$\Delta W_{ij} = \eta \delta_i x_j + \alpha \Delta W_{ij}(k-t) \quad \text{.... (1.1)}$$

Where W_{ij} is the weight connecting an output of unit j into an input of unit i, η is the step size, a is a momentum coefficient, and xj is an input signal from unit j. The quantity δ_i is an error term, computed as

$$\delta_i = \begin{cases} O'i(ti - Oi) \\ O'i \sum W_{mi} \delta m \end{cases} \quad \text{.....(1.2)}$$

Where ti is a desired signal to unit I, Oi is the actual output of unit i, and O'i is the derivative of O'i. Weight is adjusted according to what is the target. When there is much difference between input and target then neural network needs more training. When epochs are increased neural network gives best response as the number of epochs increased training is better, although with increasing number of times taken to train the network is more but target is achieved with less mean squared error [4].

5. METHODOLOGY

In this methodology first the searching of watermark is done for that a document is split into blocks. Block size of each block is equal to the size of ideal watermark. After splitting each block is stored in different variable. After splitting document into blocks further process is that to correlate each block with ideal watermark. This correlation will give the correlation coefficient. Block which contains watermark gives the highest correlation coefficient. Now we extracted the block which gives us highest correlation coefficient and give it to neural network. Correlation coefficient [3] is given by the equation (1.3)

$$c(s,t) = \sum\sum f(x,y) w(x-s, y-t) \quad \text{..... (1.3)}$$

Where x, y are co-ordinates of selected block and s=0, 1, M, t= 0,1, 2,……N Where M×N is size of ideal watermark. Each pixel of the selected block is matched with each corresponding pixel of ideal watermark block. Difference between these is calculated called correlation coefficient. Correlation coefficient of each block has been calculated with the same procedure. Now select the block which contains the highest correlation coefficient. The system software flowchart is shown in figure 1 can be described; the location of the water mark is detected [7].

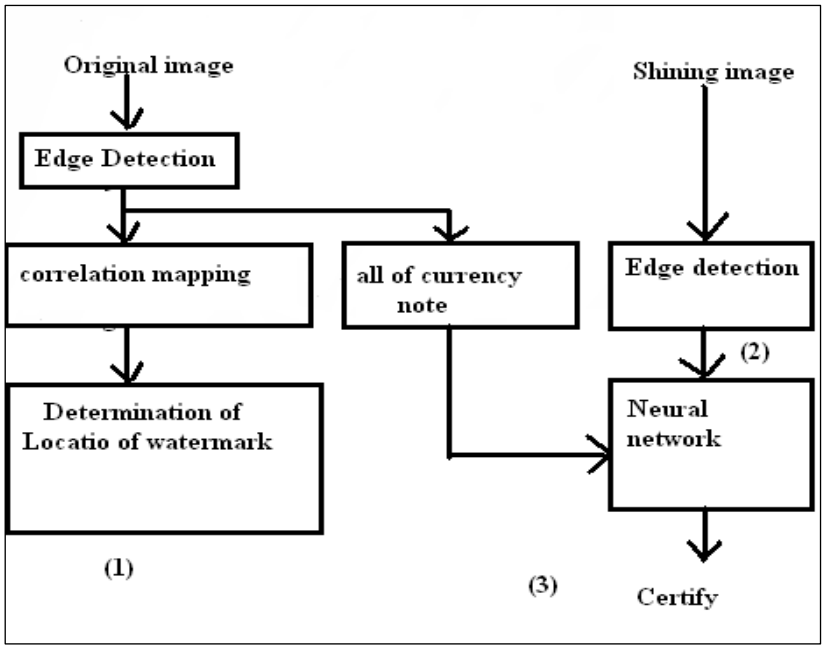

Fig. 1: Flowchart of a system

The edge information from the shadow of water mark is derived from shining image, and it is inputted to neural network for certifying. The edge information all of currency note is inputted to neural

network for checking.

6. The Proposed Solution

We are applied an algorithm which tries to find the watermark more effectively. First step to break the image into different pieces having size of each piece is equal to ideal watermark size. Then it finds the correlation among each piece with ideal watermark. Correlation process gives correlation coefficients then the method picks up the piece which gave greatest correlation coefficient, because this piece has most probably of containing watermark. The piece found in the previous step has been given to the neural network for verification. We trained the neural network with ideal watermark as a target.

This is implemented in matlab 7.0 and vb.net. GUI has been created in vb.net and main implementation has been done in matlab 7.0. Then GUI is linked with matlab7.0 with the help of M-files.

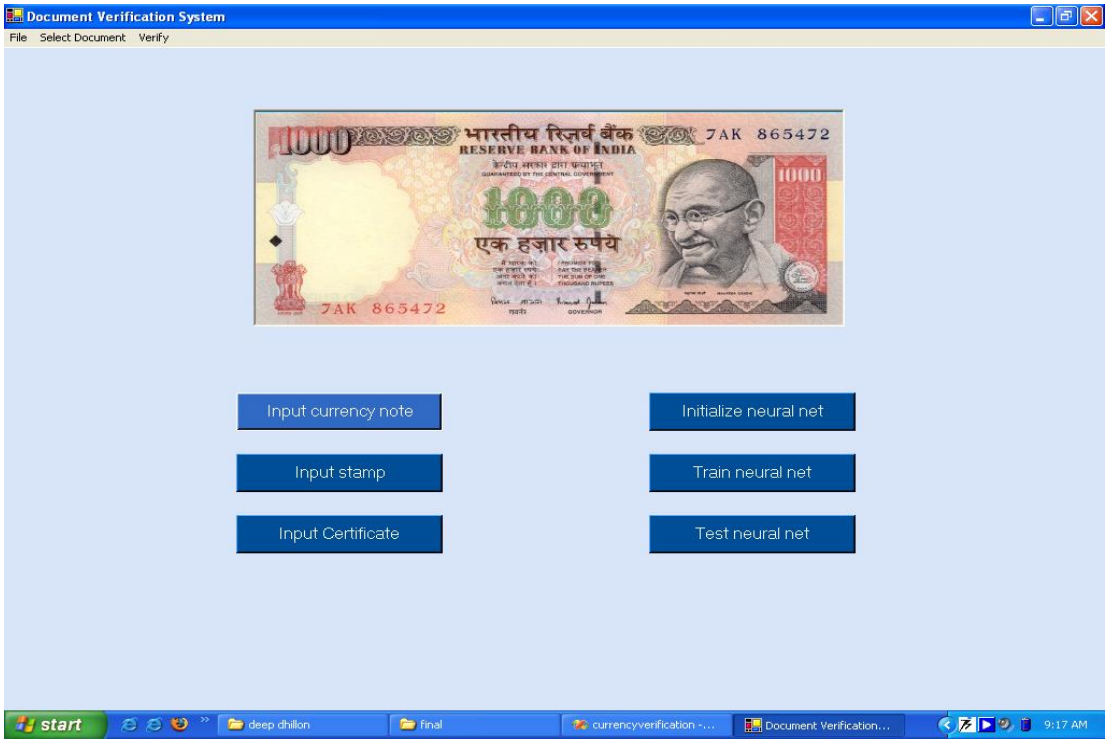

Fig. 2: Form of GUI, "Document verification system"

In fig 2 photo of the currency note 1000 has been shown. After acquiring image the neural network has been trained. Following figure 3 shows the training of neural network.

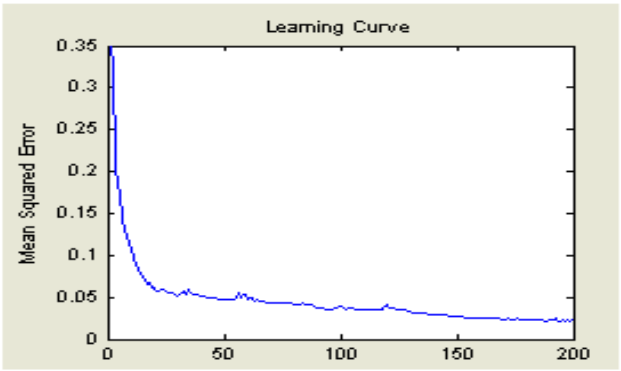

Fig. 3: Training of Neural Network

After clicking ok main form displayed again then we have to verify it. By selecting verify from the menu bar will start process of verification. Following graph in figure 4 shows the watermark accuracy present on the document.

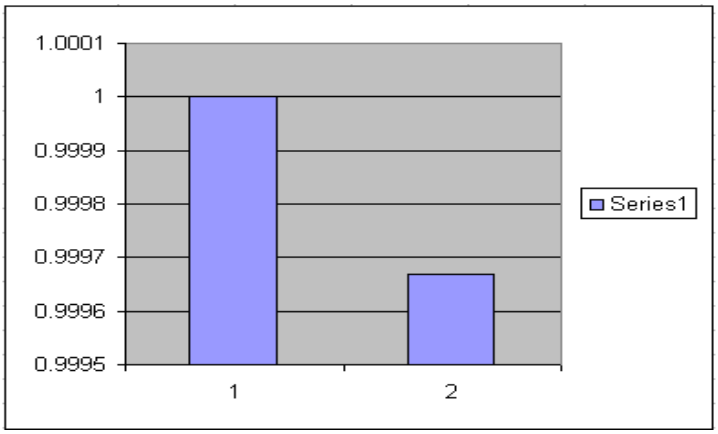

Fig. 4: Accuracy of the document

7. RESULTS

The note is divided into two categories one is called training set other is called testing set. After inputting the note's image of currency notes, the location of watermark has been detected by correlation mapping by splitting image into blocks then finding correlation of each block. Then block is given to neural network for certification. Neural network is trained through training set. After the goal is accomplished, we test the neural network by tested data. In this neural network Mean squared error has been used. So training graph has been plotted target versus input. So the neural network has been trained with 1000 epochs.

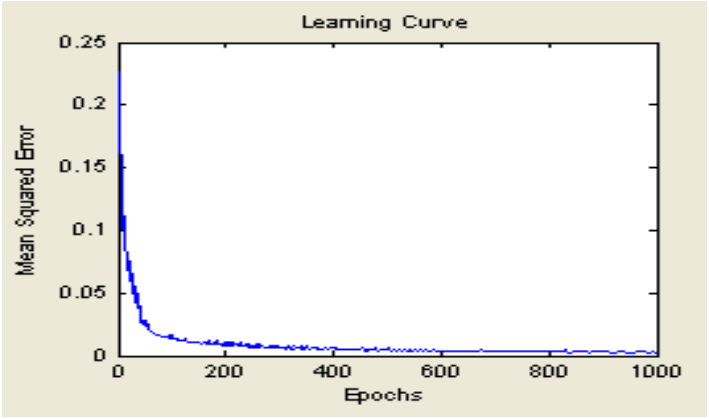

Fig. 5: Training neural network with 1000 epochs

This bar chart is plotted on scale 1. First watermark shows the accuracy of 99% and second watermark shows the accuracy of 100% which are above threshold so we can say that the currency note is real. This accuracy is checked on the basis of percentage matching with real watermarks because neural network has been trained with the real watermark and gives mean squared error when tested. Two neural networks for two watermark has been created differently. If accuracy is below threshold, then the note is rejected.

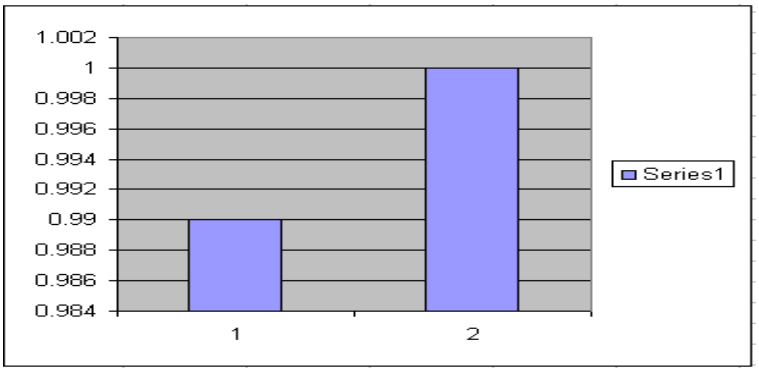

Fig. 6: Bar chart showing percentage accuracy of two watermarks

We have implemented our technique on the Indian currency and Indian postage stamp, but their technique is implemented on Thai currency. However, output of this technique is also different it did not show the accuracy of watermark. This technique searches the watermark into whole image while our technique will split the image into blocks and apply correlation on each block with ideal watermark, which gives us a correlation coefficient. The value of correlation coefficient gives us an idea of similarity between two images. This technique takes shorter time to find the watermark in the note.

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