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RECOGNISATION OF NEW INDIAN FAKE CURRENCY BASED ON THE COMBINATION OF FEATURES USING NEURAL NETWORK

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Abstract: *This paper presents the various fake currency detection techniques. Fake currency is imitation currency produced without the legal sanction of the state or government. Production and printing of Fake notes of Rs.100, 200, 500 and 2000 are degrading economic growth of our country. From last few years due to technological advancement in color printing, duplicating, and scanning, counterfeiting problems are coming into picture. So, Fake currency detection system has become more and more important. In this paper verification of fake currency note is done by the concepts of image processing. MATLAB is used to extract the features of the real and fake notes. The comparison between the features will predict whether the currency note is fake or not.*

Key Words*: *Indian currency, recognition, segmentation, security features

1. INTRODUCTION

Fake currency detection is a serious issue worldwide. Currency duplication also known as counterfeit currency is a vulnerable threat on economy. It is now a common phenomenon due to advanced printing and scanning technology. The possible solutions are to use either chemical properties of the currency or to use its physical appearance. The approach presented in this paper is based upon physical appearance of the Indian currency. Image processing algorithms with MLP are being adopted to extract the features, such as security thread, intaglio printing (RBI logo) and identification mark like, Gandhi symbol which have been adopted as security features of Indian currency for training and testing purpose.

2. PREVIOUS WORK

Li Liu et al. [1] introduce a new approach to detect fake coins using their images. To recognized key points they used DOG and SIFT detector. Ying Li Tian [2], describes an Effective Component-based Banknote Recognition for the Blind. Author Bo Tang, Steven Kay, Fellow, and Haibo [3], describes a novel shape feature—angle-distance methodology. Mohammad H Alshayeji [4], elaborates a technique to Detection Method for Counterfeit Currency Based on Bit-Plane Slicing Technique. Nayana Susan Jose and Shermin Siby [5], introduce an Android Based Currency Recognition System for Blind people. Mirza and Nanda [6], describe an automated paper currency recognition system which can be a very good utility in banking systems and other field of commerce.

3. PROPOSED METHOD

Indian currencies have different colour, texture and different size. Hence representative dataset should contain different variables. The proposed system is designed to recognize and verify whether the currency is fake or not. Some samples of Indian currency are shown in fig 1.

Fig 1: Samples taken for this paper

The approach consists of a number of steps including image acquisition, gray scale conversion, edge detection, feature extraction, image segmentation and comparison of images as shown in figure 2.

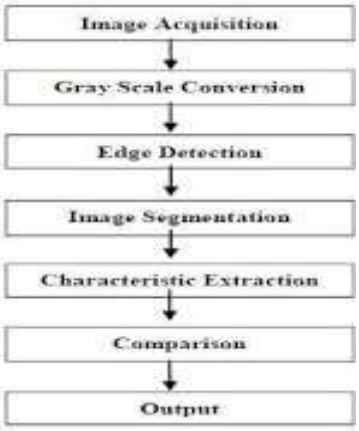

Fig 2: Block Diagram of Proposed Method

3.1 Image Acquisition

Image is acquired by digital camera by applying the white backlighting against the paper currency so that the hidden attributes are able to appear on the image of the currency.

3.2 Gray-scale conversion

The image acquired is in RGB color. It is converted into gray scale because it carries only the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue). Image is acquired in step 1 is large to continue process and colour information is not needed, except the colour index. First, RGB image is converted to pixel values and then to gray scale.

3.3 Edge detection

It is the fundamental tool in image processing, which aim at identifying points in digital image at which the image brightness changes sharply or has discontinuities. There are many ways to perform edge detection. . Edges are detected of the gray scale image of paper currency using Prewitt operator. It smoothes the image and calculate the gradient of the image. Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques.

3.4 Image segmentation

Segmentation is the process of partitioning a digital image into multiple segments. It is typically used to distinguish objects from backgrounds. Here edge based segmentation is performed on the image. Image segmentation sub divides the image into its constituent regions or objects.

3.5 Feature extraction

Now the features are extracted using edge based segmentation and objects and background are separated. It is a challenging work in digital image processing. In any currency recognition system, feature extraction is one of the most challenging tasks. Here, the aim is to analyze and identify the unique and distinguishing features of each denomination under various challenging conditions such as old notes, worn out notes, also under different illumination and background.

Texture Features: Texture refers to visual patters or spatial arrangement of pixels. It cannot be described by a single color or intensity value. It is modeled by variations of gray level over the image. It is computed from a set of gray-level co-occurrence matrices (GLCM). GLCM defines the probability of gray level *i* in neighborhood of gray level *j* at a distance *d*. Formally,

$$G = \Pr(i, j \mid d, \theta)$$

Directional GLCMs can be computed along three other directions viz. Right-diagonal ($\theta = 45^{\circ}$), vertical ($\theta = 90^{\circ}$) and left-diagonal ($\theta = 135^{\circ}$).GLCM based features are contrast (GC), homogeneity (GH), energy (GE), correlation (GN) respectively. Here P (i, j) represents the (i, j)-th element of a normalized symmetrical GLCM and N denotes the number of gray levels then

$$GC = \sum_{i=1}^{N} \sum_{j=1}^{N} P_{i,j} (i - j)^2 \quad \text{..... (1)}$$

$$GH = \sum_{i=1}^{N}\sum_{j=1}^{N}\frac{P_{i,j}}{1+|i-j|} \quad \text{..... (2)}$$

$$GE = \sum_{i=1}^{N}\sum_{j=1}^{N}(P_{i,j})^2 \quad \text{..... (3)}$$

$$GN = \sum_{i=1}^{N}\sum_{j=1}^{N}\frac{(i-\mu i)(j-\mu j)P_{i,j}}{\sigma_i\sigma_j} \quad \text{..... (4)}$$

Shape Features: First the color image is converted to grayscale image. Then it is converted to black and white image using Otsu Threshold with a threshold level of 0.25. Then the color features like Area, Centroid, MajorAxisLength, MinorAxisLength, Perimeter and Filled Area are extracted. For each image the shape features are represented by some element vectors, like,

FS = {Area, Centroid, MajorAxisLength, MinorAxisLength, Perimeter, Filled Area}

3.6 Comparison

Lastly the extracted features of test currency are compared with the extracted features of original currency. If extracted features are equal then currency is original otherwise fake.

3.7 Output

We can understand if the currency is real or fake by seeing the efficiency.

3.8 Classifier

A multi-layer perceptron using back propagation algorithm has been used (MLP). In the training phase the input feature vector is mapped to the known output class. Weights are iteratively adjusted to reduce the error at output. At the end of the training phase the correct weights are determined. In the testing phase an unknown feature vector is mapped to an estimated class using pre-determined weights. The test samples are not exactly same as the training samples. 75% of the images in the dataset are fed to the neural network to learn the characteristics shape, color and texture, while the other 25% are subsequently treated as unknown test samples to evaluate the performance of the system. The percentage classification results are reported in the experimentations section.

4. EXPERIMENTAL RESULTS AND ANALYSIS

To test the performance of the proposed system, experiments were performed on a dataset of 80 for real and 80 for fake images of 4 Indian currencies that includes: 100,200, 500, and 2000. Each training dataset contains 60 images whereas each testing dataset contains 20 images. We considered a Shape and Texture feature sets for the currency description. For texture features we have used glcm property, Correlation, Energy, Contrast, Homogeneity. For shape feature we have used area, centroid, major axis length, minor axis length, perimeter etc. After combining shape and texture features, a vector is created and fed to MLP that will assign to the segment four predefined currency classes.

The topology of the neural network used for classification of four Indian currencies is shown in Fig. 3. It uses a 22-18-4 architecture i.e. 22 input nodes for the combined feature vector, 18 nodes in hidden layer and 4 output nodes for accommodating 4 spices. A Tan-sigmoid activation function $y = \frac{1-e^{-x}}{1+e^{-x}}$ for the hidden layer is used

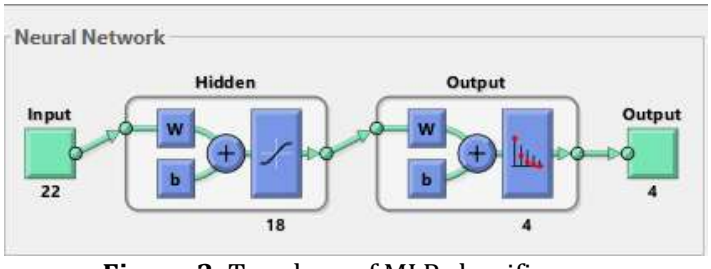

Figure 3: Topology of MLP classifier

$$AccuracyPercentage = \frac{TruePositive + TrueNegative}{(TruePositive + FalsePositive) + (TrueNegative + FalseNegative)} \times 100$$

Where, True positive (TP) : pixels correctly segmented as foreground. False positive (FP): pixels falsely segmented as foreground. True negative (TN): pixels correctly detected as background. False negative (FN): pixels falsely detected as background. These metrics are then used to calculate sensitivity, specificity and accuracy for classification performance. The sensitivity tells us how likely the test is come back positive in someone who has the characteristic. This is calculated as TP/ (TP+FN). The specificity tells us how likely the test is to come back negative in someone who does not have the characteristic. This is calculated as TN/ (TN+FP). Finally accuracy is (TP+TN)/ (TP+FP+TN+FN). Here, we obtained an efficiency of 25% for detection of fake currency shown in fig 4 below. Because we trained the neural network with real currency image and tested it using fake image. So, very satisfactorily we achieved very low efficiency as there is a property mismatch between real and fake one.

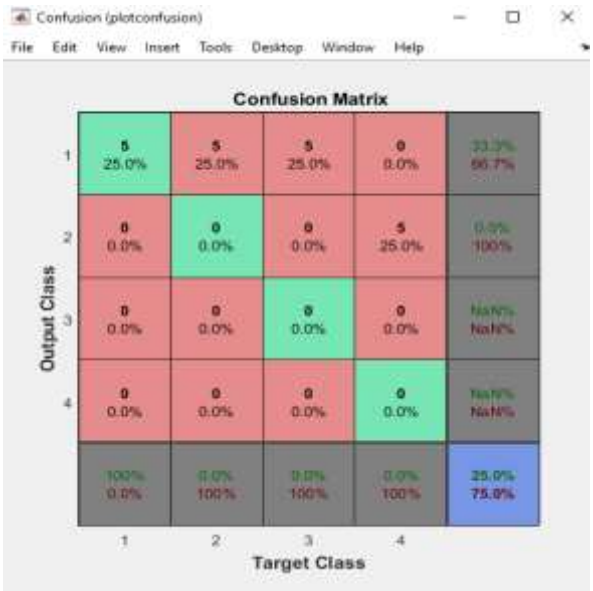

Figure 4: Confusion Matrix using combined features (Fake Case)

We obtained an efficiency of 70% for detection of real currency shown in fig 5 below. Because we trained the neural network with real currency image and tested it using real image. So, very satisfactorily we achieved higher efficiency.

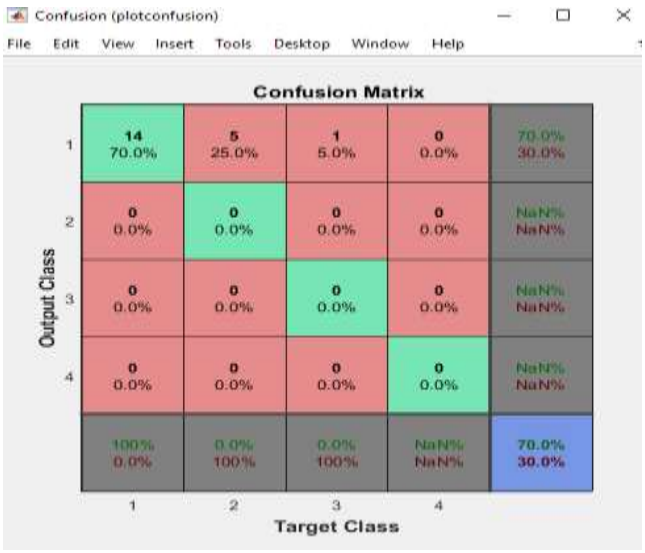

Figure 5: Confusion Matrix using combined features (Real Case)

5. CONCLUSION AND FUTURE SCOPE

By using digital image processing, analysis of Currency image is more accurate as well as this method is efficient in terms of cost and time consuming compared to existing techniques. MATLAB Software is used for this analysis. Day by day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate results. The proposed system is worked effectively for extracting features of Indian currency images.

Extracted features of currency image will be using for currency value recognition as well as for its verification. In Future, Application based system shall be designed to get proper result whether currency image is fake or genuine.

6. REFERENCES

[1] Liu, Yue Lu —An Image-Based Approach to Detection of Fake Coins|| in IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY June 2017.

[2] A Roy —Machine-assisted authentication of paper currency: an experiment on Indian bank notes|| International Journal on Document Analysis and Recognition, 18(3): 271-285, 2015.

[3] Sun. Ke, —Detection of Counterfeit Coins and Assessment of Coin Qualities|| IEEE Conference 2015.

[4] R. C. Gonzalez and R. E. Woods, Digital Image Processing, 2nd ed., Prentice Hall India, ISBN-81-203-2758-6, 2006.M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989

[5] Ms.Rumi Ghosh, Mr Rakesh Khare, —A Study on Diverse Recognition Techniques for Indian Currency Note||, IJESRT,Vol.2, Issue 6, June 2013.R. Nicole, —Title of paper with only first word capitalized,|| J. Name Stand. Abbrev. In press.

[6] Amol A. Shirsath S. D. Bharkad, —Survey of Currency Recognition System Using Image Processing||, IJCER, Vol.3, Issue 7, pp 36-40, July 2013.

[7] M.Deborah and Soniya Prathap —Detection of Fake currency using Image Processing||. IJISET-International Journal of Innovative Science, Engineering & Technology, Vol. 1, Issue 10, 2014.

[8] Rubeena Mirza, Vinti Nanda, Characteristic Extraction Parameters for Genuine Paper Currency Verification Based on Image Processing, IFRSA International Journal of Computing, Volume 2, Issue 2, April 2012.

[9] Komal Vora, Ami Shah, Jay Mehta, A Review Paper on Currency Recognition System, International Journal of Computer Applications (0975 – 8887) Volume 115 – No. 20, April 2015.

[10] G. Trupti Pathrabe, Mrs.Swapnili Karmore, A Novel Approach of Embedded System for Indian Paper Currency Recognition, International Journal of Computer Trends and Technology, May to June Issue 2011, ISSN: 2231-2803

[11] E.H.Zhang, B. Jiang, J. H. Duan, Z. Z. Bian," Research on Paper Currency Recognition by Neural Networks", Proceedings of the 2nd Int. Conference on Machine Learning and Cybernetics, 2003.

[12] Jae-Kang Lee and Hwan Kim, "New Recognition Algorithm for Various Kinds of Euro Banknotes" 0-7803-7906-3/03/2003 IEEE.

[13] F.H Kong, J.Quab Ma , J.Feng Liu,"Paper Currency Recognition Using Gaussian Mixture Models based on Structural Risk Minimization" Proceedings of the Fifth International Conference on Machine Learning and Cybernetics, Dalian,13-16 August 2006.

[14] Ji Qian,Dongping Qian,Mengjie Zhang,"A Digit Recognition System for Paper Currency Identification Based on VirtualInstruments"1-4244-0555-6/06 © 2006 IEEE.

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