Indian Paper Currency Recognition Using Weighted Euclidean Distance

M. Thuslima, V. Sudha, P. Selva Nila, G. Bharatha Sreeja

ECE Department, PET Engineering College, Vallioor, Tamil Nadu, India

ABSTRACT

Paper currency recognition plays a vital role in area of pattern recognition. One of the intelligent systems is recognition of paper currency. Electronic banking, money exchange machine, currency monitoring system, etc are the important application of currency recognition. This paper proposes the detection of currency using currency recognition system. Some of the features are fished out like dimension, area, Euler's number, correlation between images. The method includes only Indian paper currency. It uses weighted Euclidean distance for classification. This method uses both the original and fake currency. Both the currencies are identified by using MATLAB. The proposed technique produces the accurate result in terms of efficiency and recognition.

Keywords : Paper Currency, Money Exchange, MATLAB, Correlation.

I. INTRODUCTION

Object recognition is highly used in area of pattern recognition. Any type of object can be used in our everyday life. It can be document's text, iris in a person's eye, license plate of a vehicle and so on. In recent years, paper currency recognition system is subjected as a contribution by some of the authors. The reader is referred to [9]-[15], for brevity. Image processing, weighted Euclidean distance and neural network techniques are mainly used in paper currency recognition system in some existing method [15]-[11]. This design system deals with a very accurate, simple and efficient approach. In this system, it considers few features like correlation, dimension, Euler's number and area. For recognizing paper currency, this research is specifically designed. It is used to recognize the fake and original currency of 50 rupees Indian paper currency. In recent year, fake currency is used often. To overcome the problem of dirty note recognition, the pre-processing stages are used.

This paper is different from various existing methods [1]-[21]. For example, masking [11] of the image is done in a paper currency. In this method, it computes all the masked and non-masked pixel values and fed into the weighted Euclidean distance classifier. In technique [21], it is designed in such a way that the proposed system is different from the introduced one because of more number of features are used in this.

The paper currency can be recognized by the following steps:

1. PCR's overall mechanism,
2. Pre-Processing,
3. Problem formulation for the Indian PCR system,
4. The features and classification has been completely explained in the proposed approach,
5. Demonstration of currency,
6. Finally, it is concluded.

PCR SYSTEM STRUCTURE

The system is designed to recognize the Indian paper currency. Input image is scanned using scanner or digital camera. Output is the recognition of currency using some of the feature exposed. This system uses few modules: image scanning, pre-processing like feature fish out, classification and recognition. It is used in fig1.

II. METHODS AND MATERIAL

Proposed System

The objective of the paper is to recognize both the original and fake currency. First is to produce suitable features for both currencies.

Feature Expose:

The input vector with some feature is given as follows:

f(h,w,a1,a2,a3,e,r);

h: image height(pixel)
w: image width(pixel)
a1: image area without mask
a2: image area with first mask
a3: image area with second mask
e: Euler number of the image
r: image correlation with template images

Euler's number of an image is a scalar value which represents the number of object minus the total number of holes in those objects[5].

$$\text{Euler's number} = \text{Euler} = \sum(O - H_0)$$

Where O stands for any object in the image, and H_0 stands for any hole in that object. In fact, Euler is an attractive feature of the currency image, since it makes use of the whole image, whose distinctive features are spread in much different position.

r- Correlation coefficient between two images [5].

The value of r ranges between 0 and 1. If the value of r is greater, then the two matrixes are relatively same. The correlation coefficient of two different image matrices gives very important information about the similarity matching between them. It can be evaluated by the above formula.

The used neural network classifier contains 25 neurons in the hidden layer. The correlation are not available, when the image is input, all the correlations are calculated by the system, then it builds and the network is trained, and finally it classify the image.

CLASSIFICATION

The Weighted Euclidean Distance is defined as the distance between two vectors, with certain weights given to each element of the vector.

$$d = \sqrt{0.5\left(a - \hat{a}\right)^2 + 0.0005\left(\left(a_1 - \hat{a_1}\right)^2 + \left(a_2 - \hat{a_2}\right)^2 + \left(a_3 - \hat{a_3}\right)^2 + (e_1 - e_2)^2\right) - 1000r} \to 1$$

A. Performance Measures

Table 2

SI.NO	TP	TN	FP	FN
1	10	0	1	0

B. Parameters

Table 3

Specificity	Infinity
Sensitivity	1
Elapsed time	4.209466 seconds
Efficiency	100%

III. CONCLUSION

Paper currency recognition is one of the most important applications of pattern recognition. Based on correlation between images another method of recognizing currencies has been introduced. The method is reasonable in term of accuracy. There is a reasonable achievement in the processing time too. The minimum distance classification was used by taking the weighted Euclidean Distance with 100% accuracy rate.

In future the algorithm proposed here is fully automatic and requires no human invention. The recognition uses two classifiers based on two categories. The Neural Network with feed forward back propagation was used as another classification technique. Using Neural Networks many studies were made to recognize paper currencies.

IV. REFERENCES

[1] H. Hassanpour, P.M. Farahabadi, Using Hidden Markov Models for paper currency recognition, Expert Systems with Applications, Vol. 36(6), pp. 10105-10111, 2009.

[2] R.C. Gonzalez, R.E. Woods, Digital image processing, Prentice Hall, 2009.

[3] H. Hassanpour, M. Mesbah, Neonatal EEG seizure detection using spike signatures in the time-frequency domain. In IEEE, 2003.

[4] H. Hassanpour, A. Yaseri, G. Ardeshir, Feature Extraction for Paper currency Recognition. In International symposium on signal processing and its applications (ISSPA), Sharjah, UAE, 2007.

[5] M. Iosifescu, Finite Markov process and their applications. New York, NY: Wiley, 1980.

[6] L.S. Jae, Two-dimensional signal and image processing. Englewood Cliffs, NJ: Prentice Hall, 1990.

[7] M. Kim, D. Kim, S. Lee, Face recognition using the embedded HMM with second-order block-specific observations. Pattern Recognition, 36(11), pp. 2723–2733, 2003.

[8] A. Vila, N. Ferrer, J. Mantecon, D. Breton, J.F. Garcia, Development of a fast and non-destructive procedure original and fake euro notes. Analytica Chimica Acta, 559, pp. 257–263, 2006.

[9] E.H . Zhang,, B. Jiang, J.H. Duan., Z.Z. Bian, Research on paper currency recognition by neural networks. In Proceeding of the second international conference machine learning and cybernetics, 2003.

[10] Ali Ahmadi, Sigeru Omatu, and Michifumi Yoshioka; "Implementing a Reliable Neuro-Classifier for Paper Currency Using PCA Algorithm", SICE, pp. 2466-2488, August 2002.

[11] F.Takeda and S.Omatu; "High Speed Paper Currency Recognition by Neural Networks", IEEE Transaction on Neural Networks, Vol.6(1), pp. 73-77, 1995.

[12] F.M. Hasanuzzaman, Xiaodong Yang, and YingLi Tian, "Robust and effective component-based banknote recognition by SURF features," 20th Annual Wireless and Optical Communications Conference, pp. 1 -6, 2011.

[13] Jianbiao He, Zhigang Hu, Pengcheng Xu, Ou Jin, and Minfang Peng, "The design and implementation of an embedded paper currency characteristic data acquisition system," International Conference on Information and Automation, pp. 1021 -1024, 2008.

[14] Guo Junfang, Zhao Yanyun, and Cai Anni, "A reliable method for paper currency recognition based on LBP," 2nd IEEE International Conference on Network Infrastructure and Digital Content, pp. 359 -363, 2010.

[15] E. Althafiri, M. Sarfraz, M. Alfarras, Bahraini Paper Currency Recognition, Journal of Advanced Computer Science and Technology Research, Design for Scientific Renaissance, Vol.2(2), 2012, pp. 104 – 115.

[16] A.B. Sargano, M. Sarfraz, N. Haq, An Intelligent System for Paper Currency Recognition with Robust Features, Journal of Intelligent and Fuzzy Systems, IOS Press, Vol. 27(4), 2014, pp. 1905 – 1913.

[17] M. Sarfraz, An Intelligent Paper Currency Recognition System, International Conference on Communication, Management and Information Technology (ICCMIT 2015), Prague, Czech Republic, Journal of Procedia Computer Science, ELSEVIER, in press.

[18] From Wikipedia, the free encyclopedia, Saudi Riyal, http://en.wikipedia.org/wiki/Saudi_riyal.