

Universal Currency Identifier

Ajay S. Wadhawe¹, Sudhamma U. Landge²

¹Dept. of Electronics & Telecommunication, SRTMUN, Nanded, Maharashtra, India.

²PG Student, Dept. of Electronics and Telecommunication, Shri Shivaji Institute of Engg & Management Studies, Parbhani, Maharashtra, India

Abstract - The system proposed in this research paper is Universal currency identifier for Indian as well as foreign currency. For the proposed system we are using Indian paper currencies and foreign currencies like Dirhams currency of UAE, Rupiah currency of Indonesia, Ringgit the currency of Malaysia, Yuan the currency of China. In this system we will detect the currencies using image processing techniques. For this system the basic techniques used is, we will acquire the paper currency images first with three approaches using android phone cam with the help of IP address, by using camera, and by using database where images are already stored. Then some basic operations like resizing, filtering, some conversions like RGB to gray. Image segmentation is performed then finally the features are compared by classifier. And as a result we will get the currency identification of currencies of various countries. This system have multiple uses like in banking domain, money exchange offices, malls, as well as it can be used by the blind people.

Key Words: Paper currencies of India, UAE, Indonesia, Malaysia, China, Image acquisition using IP Cam and USB camera, pre-processing, segmentation, classifier.

1. INTRODUCTION

All over the world there are about 50 currencies present whose appearance texture, size, length, color, pattern and other features are totally different from each other. So in work where people have to deal with these various currencies they have to remember the features of all currencies and have to be accurate so for such kind of application proposed system can be efficient. Because the basic aim of the proposed system is to identify the various paper currencies of different countries in a system using Image processing.

Various kinds of others currency recognition systems and devices are available internationally. But by considering the physically impaired people we have designed the system in which there is buzzer which can alert the person about the fake currency detection. A single system can be used for multiple currencies that is why the suggested name Universal currency identifier.

The basic techniques of image processing used in the proposed system is image acquisition by IP cam, preprocessing of the acquired image, segmentation of image for feature extraction and classifier for the comparison of the image with the trained images.

Preprocessing consist of resizing, filtering, conversion of RGB to gray, segmentation for feature extraction, and knn classifier for comparison.

2. LITERATURE SURVEY

There are several systems and devices available for currency identification and recognition, few supports only particular countries' currencies and few supports only identification but this system identification an fake note detection too. [1].according to central rules of Shri Lanka the paper currencies are to be denominated after particular duration of time and therefore when the currencies has been denominated then there was only slight difference of length, size and feature of Shri Lankan's currencies and therefore it was a tough task for visually impaired people so K. Wickramasinghe and D. De Silva has proposed a system which was able to identify the currencies having only 5mm length difference from each other.

[2]. The system designed by Hamid Hussnapour was able to extract certain features of the currencies and compares with the database to identify the currency.

[3].In the paper a method is designed which processes the image then extract the features for recognition. For that Weiner filter is applied on the input image and image is converted to gray scale too. The features used by this method are diagonal vector then this feature is used for comparison with the set of values from database for identification.

[4].The system called Canadian banknote reader was producing the voice output on identification of Canadian currencies but that was limited only for Canadian currencies

[5]. the novel approach by Jong k wang was designed to recognize Korean bank note with the help of RGB color and UV information as feature of currency. This method involves the RGB color information to classify the bank note, size is one of the parameter improved the accuracy. Training overhead of back propagation neural network is because of its slow convergence speed and indeterminate initial weights. Training of neural network require more time because of the rigorous need of samples. Since training time for a back propagation neural network is exceedingly high they are not considered for a real time system.

3. SYSTEM DESIGN, ARCHITECTURE AND WORKING

By doing the literature survey and the work been already done with the respective topics observing their drawbacks it's an attempt to overcome few of them and to give more accurate result in less time.

The proposed system consist both the hardware and software that is Matlab code. Basically in software part consist of Matlab code for recognition of the paper currencies as well as some controller programming. And in hardware part the AVR controller, LCD for displaying the output, buzzer to alert about the fakeness of currency.

The flow of the working is like the capturing of image, performing pre processing, segmentation for feature extraction, classifier for comparison. Figure 1 shows the basic block diagram of the system

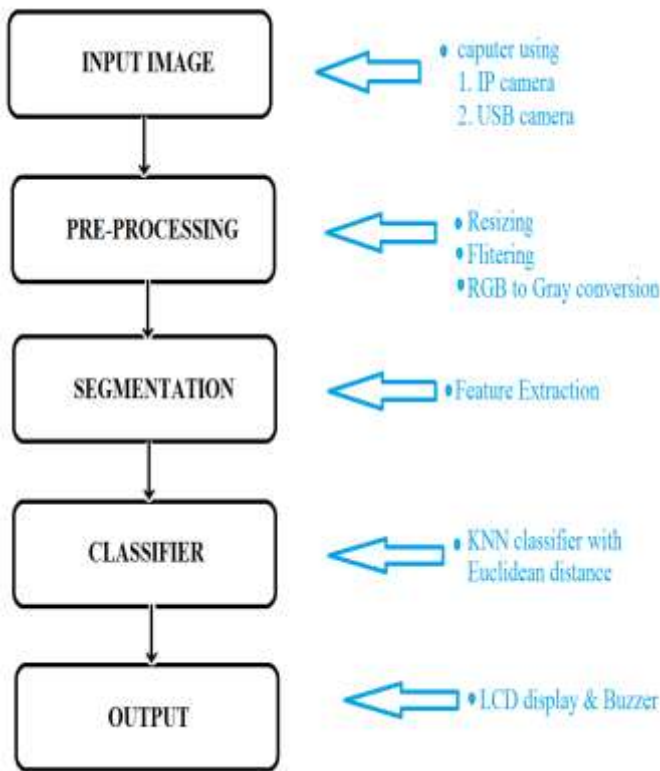


Figure 1. Basic block diagram of proposed system.

Figure1 shows the basic block diagram of the proposed system which consist of the following stages

- I. Input Image – this is the very first step in which we will do image acquisition in two ways that is with the help of USB camera and IP cam from mobile phone. The steps to connect the IP camera of any android mobile phone to the Matlab.

Step1: Install “IP Webcam” android application from playstore to your mobile phone.

Step2: connect the mobile phone to host pc through WIFI

Step3: write some additional code for interfacing like

`I = imread(“IP address of mobile web cam”)`

- II. Per-Processing – in this stage the basic operations will be performed like resizing, filtering, RGB to gray conversion.

Image resizing – resizing is nothing but the geometric transformation of each pixel. The mapping between corresponding pixel of input and output images is known as image resizing. Basically interpolation is used to achieve the resizing. There are various types of interpolation in matlab like nearest neighbor, bilinear, bicubic interpolation. Nearest-neighbor interpolation the output pixel is assigned the value of the pixel that the point falls within no other pixels are considered. Bilinear interpolation the output pixel value is a weighted average of pixels in the nearest 2-by-2 neighborhood. Bicubic interpolation the output pixel value is a weighted average of pixels in the nearest 4-by-4 neighborhood.

Median filter – when we capture the image some noise get added to the image one of the most occurred noise is salt and paper noise to remove this noise we use median filter. Median filter perform the filtering on image in two dimensions. Each output pixel contains the median value in 3 by 3 neighborhood around the corresponding pixel in the image with zeros on the edges.

- III. Segmentation – in this stage the feature extraction. The features we are using are LUV transformation, edge histogram, gray level co-occurrence matrix. The features are as follows-

Mean- mean of the color is obtained by taking average value of all of the color component of the color space used.

$$\mu = \frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N p_{ij}$$

where, M,N= dimension and total number of pixels in image

p_{ij} = color values of column i and row j

Standard deviation - it is a quality that express the how much the member of color channel differ from mean value for channel.

$$\sigma = \sqrt{\frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N (p_{ij} - \mu)^2}$$

Skewness- it is used to measures the degree and direction of symmetry or asymmetry of distribution.

$$\frac{1}{MN} \sum_{i=1}^M \sum_{j=1}^N (p_{ij} - \mu)^3 \div MN\sigma^3$$

For edge detection purpose we are using canny edge detector. This canny edge detector uses the Gaussian low pass filter and then takes the first derivative. it consist of following stages-

Noise reduction- the canny edge detector uses Gaussian filter with first derivative. By this the image will get smoothen using Gaussian filter with standard deviation.

Find the intensity gradient of the image - the local maxima of gradient, $g(x,y) = [G_1^2 + G_2^2]^{1/2}$ and edge detection, and $\theta(x,y) = \tan^{-1}(G_y/G_x)$ are computed at each point. Any of the above first three techniques can be used to computer the G_x , G_y . an edge point is defined to be a point whose strength is locally maximum in the direction of the gradient.

Non-maximal suppression - The edge points gives rise to the ridges in the gradient magnitude image. The algorithm then tracks along the top of these ridges and set to zero all pixels that are not actually on the ridge top so as to give a thin line, a process known as non-minimal suppression. Here a set of edge point in the form of a binary image is obtained. These are sometimes referred as thin edge.

Thresholding - canny uses the thresholding with hysteresis. The method uses two thresholds to detect weak and strong edges, and includes the weak edges in output only when they are connected to the strong edges. The ridges of pixels are thresholded using thresholds T_1, T_2 with $T_1 < T_2$. The ridge pixels with value greater than T_2 are said to be strong edge pixels and the pixels between T_1 and T_2 are said to be weak pixels.

IV. Classifier- the Knn classifier is used in the proposed system this is also known as the nearest neighbor classifier it allows to find the closest point to the set point so that it compares the test data with data base set.

4. HARDWARE DETAILS

The output of the proposed system is displayed in two ways that is by using the GUI using Matlab code and the LCD display for that we are using some hardware which mainly includes the AVR controller, LCD display, buzzer, USB camera.

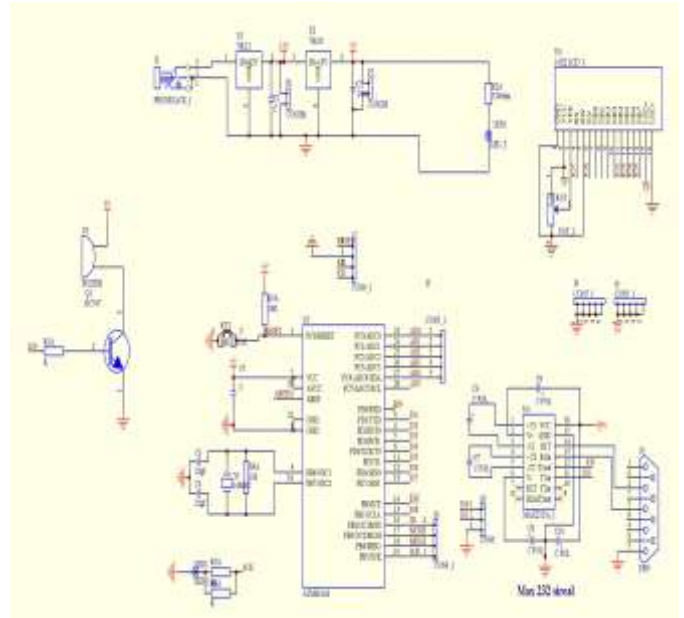


Figure 2. Schematic diagram of proposed system hardware.

The above shows the schematic diagram of proposed system which shows the circuitry connections of hardware devices.



Figure 3. Hardware setup

5. EXPERIMENTAL SETUP AND RESULT

For experimenting the proposed system we used IP web cam of android mobile phone connected to laptop with same network. Laptop must be have MATLAB software installed and other option of USB camera, the hardware of AVR controller with connection of LCD display and Buzzer as output device.

When the code is executed the graphical user interface provided in the matlab code will help us to choose the input method to acquire an image for processing. And the output will display in GUI and as well as on LCD display. And if the currency is fake buzzer will energized giving alert about fake detection this will help us for the blind people.

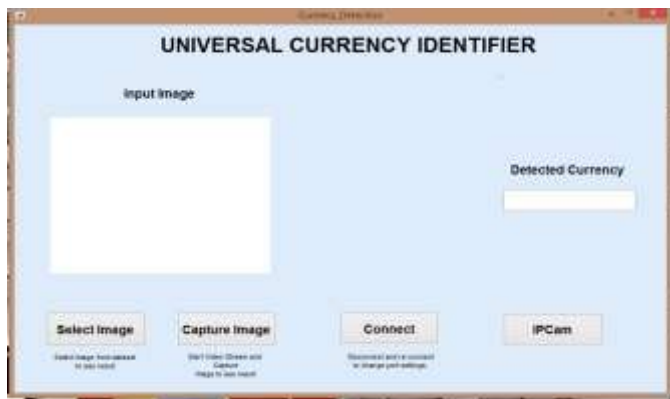


Figure 4. Graphical User Interface of the system.

Above figure shows the GUI of the proposed system which will help to choose the mode of input and the output text box is present where the output will appear.



Figure 5. Experimental setup



Figure 6. Experimental result of UAE currency(Dirham)



Figure 7. Experimental result of Malaysia currency(Ringgit)

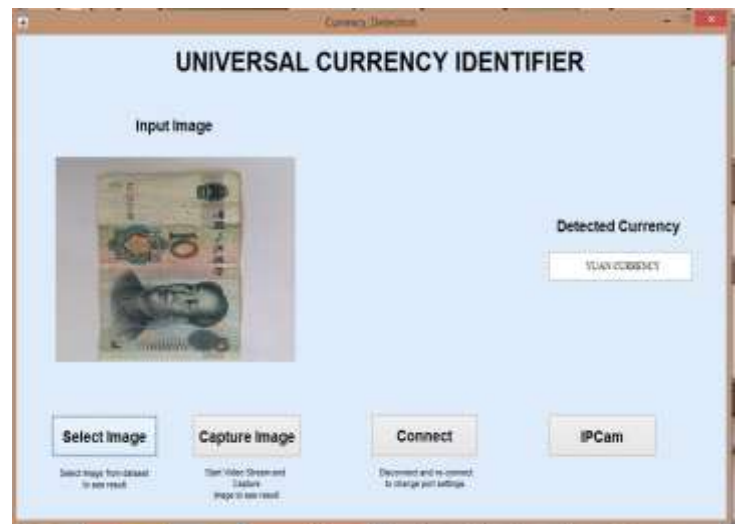


Figure 8. Experimental result of China currency(Yuan)

Note	Number of currencies tested	Correct identification
10	20	18
20	20	19
50	20	18
100	20	20
200	20	20
500	20	20
2000	20	20
Dirhams	5	4
Ringgit	5	4
Rupiah	5	5
Yuan	5	5
Fake	70	68
TOTAL	160	151

Table 1. Experimental Accuracy

Above table shows the accuracy of the proposed system in for which we have tested total 160 currencies and 151 was correct one so approximately 94% accuracy is been achieved.

CONCLUSION

This paper proposes a system for detection and recognition of paper currencies of several countries and used the IP webcam for image capturing, and image segmentation, classifier for recognition is used. Approximately 94% accuracy is achieved by the system. For the future enhancement we can have the coin detection in the same system.

REFERENCES

- [1] K. Wickramasinghe and D. De Silva, "Bank Notes Recognition Device for Sri Lankan Vision Impaired Community", In *Proc. 8th International Conference on Computer Science & Education (ICCSE 2013)*, 2013, pp 609-612.
- [2] Hamid Hassanpour and Payam M. Farahabadi. "Using Hidden Markov Models for paper currency recognition". In: *Expert Systems with Applications* 36.6 (2009), pp. 10105–10111.
- [3] Muhannad Alfarras. "Bahraini paper currency recognition". In: *Journal of Advanced Computer Science and Technology Research* 2.2 (2012), pp. 104–115.
- [4] CNIB, "Canadian Bank Note Reader", 1996 [online], Available: www.cnib.ca/en/services/products/banknote-reader [Accessed: 1st January 2016].
- [5] Chae, Seung-Hoon and Kim, Jong Kwang and Pan, Sung Bum, "A Study on the Korean Banknote Recognition Using RGB and UV Information", *Communication and Networking*, Vol. 56, Series: Communications in Computer and Information Science, pp. 477-484, ISBN 978-3-642-10843-3, 2009.
- [6] Manikandan and Sumithra. "Currency Recognition in Mobile Application for Visually Challenged." In *IEEE International Conference on Intelligent Systems and Control*, pp.460-465. IEEE, 2015
- [7] Chae, Seung-Hoon and Kim, Jong Kwang and Pan, Sung Bum, "A Study on the Korean Banknote Recognition Using RGB and UV Information", *Communication and Networking*, Vol. 56, Series: Communications in Computer and Information Science, pp. 477-484, ISBN 978-3-642-10843-3, 2009.
- [8] Er-Hu Zhang Bo Jiang Duan Jing-hong and Zheng-Zhong Bian, "Research on paper currency recognition by neural networks", In *Proceedings of International Conference on Machine Learning and Cybernetics*, Vol. 4, pp 2193-2197, November, 2003.
- [9] 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.
- [10] Pathrabe, Trupti et. al. "A novel approach of embedded system for Indian paper currency recognition." *Int. J. Comput. Trends Technol* (2011): 152-156.
- [11] Ms. 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.