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A novel approach for Indian currency denomination identification

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Abstract
It is very difficult to count different denomination notes in a bunch especially in banking. This paper proposes an image processing technique to extract paper currency denomination. The extracted ROI (Region of Interest) can be used with pattern recognition and neural networks matching technique. The pattern recognition & neural networks matching techniques are used to match or find currency value / denomination of paper currency. In this paper the serial key extraction feature will help to find originality of note.

Keywords: image processing, feature extraction, neural networks, ROI, currency denomination

1. Introduction
The Indian currency system is prevalent since a long time. The Government of India introduced its first paper money issuing 10 rupees notes in 1861 [1]. In 1938, the notes were issued are 2, 5, 10, 100 and 1000 rupees. Currently the Indian currency system has the denomination of Rs. 1, 2, 5, 10, 20, 50, 100, 500 and 1000. Every denomination notes has its value on it. In this paper we are working in Digital Image Processing domain**.** A level is set for all images. Domain of this Project will also consist of the pattern recognition and neural network process is applied for matching to identify note value.
Serial number extraction feature of given Currency for ATM system in order to prevent loss due to fake currency as serial number of fake currency will be in database and consumer can claim for the loss.
This paper not only overcome drawback of current system which only count number of notes and not its denomination value but also it will be added feature to current ATM system which do not store serial number of each currency note dispensed.

2. Motivation
The current scenario in Indian Banking System is that only numbers of notes are counted with the help of machine. Whenever some customer of Bank goes to deposit money in his/her account, cashier counts the number of notes using machine and deposit it into the account. It is quite time consuming if bundle consist of currency notes of different denomination value.
Another feature is proposed in this Paper is for ATM is extracting the serial no. of currency being scanned and given out to user. So even if currency having fake serial number is given to some customer, it will be kept in database and later on customer can claim for that particular note.

3. Related Work
There have been several attempts made in this field of currency denomination identification but so far identifying Indian currency along with its denomination value and as well to work on a serial number extraction is partially successful or is under process.
Otsu N.A [7] suggested Threshold detection which consists of finding threshold value for given image to convert it into black and white image so processing on pixels gets easy but this method is partially efficient.
Bonan liu [6] has implemented it on foreign currencies except Indian Currency. On foreign currencies operations performed varies for different country currencies. Harish Agarwal, Padam Kumar performed operations on Indian currencies but those are limited to some denomination value currencies. So on Indian currencies not many work is done, it is either partial or under process.

4. System Workflow
The system workflow diagram shows module by module working of this proposed system described in this paper. First we start with scanning the Indian currency with the help of flat scanner. Scanned image will be converted from RGB to pure Black and White format using gray scaling and threshold techniques. We will get exact denomination value by applying different filters and thinning algorithm, creating histogram with the help of edge detection techniques and finally serial number extraction will be achieved by thinning, scaling and OCR method. The following fig 1 gives overview of System workflow.

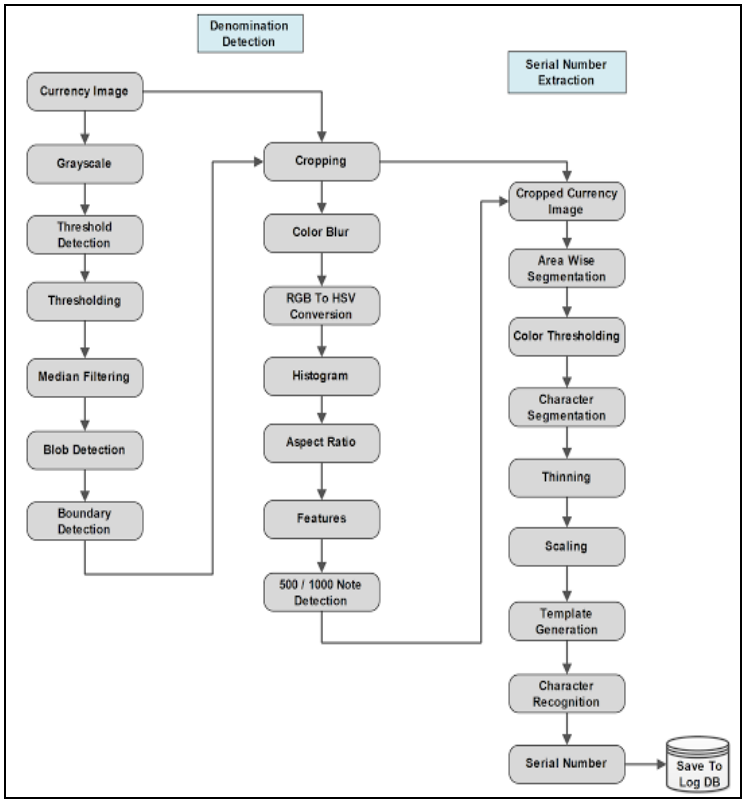

Fig 1: System Workflow [1]

a) Methodology

During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled "object" if its value is between two thresholds; and threshold outside.

The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and k-means clustering.

Recently, methods have been developed for thresholding computed tomography (CT) images. The key idea is that, unlike Otsu's method, the thresholds are derived from the radiographs instead of the (reconstructed) image.

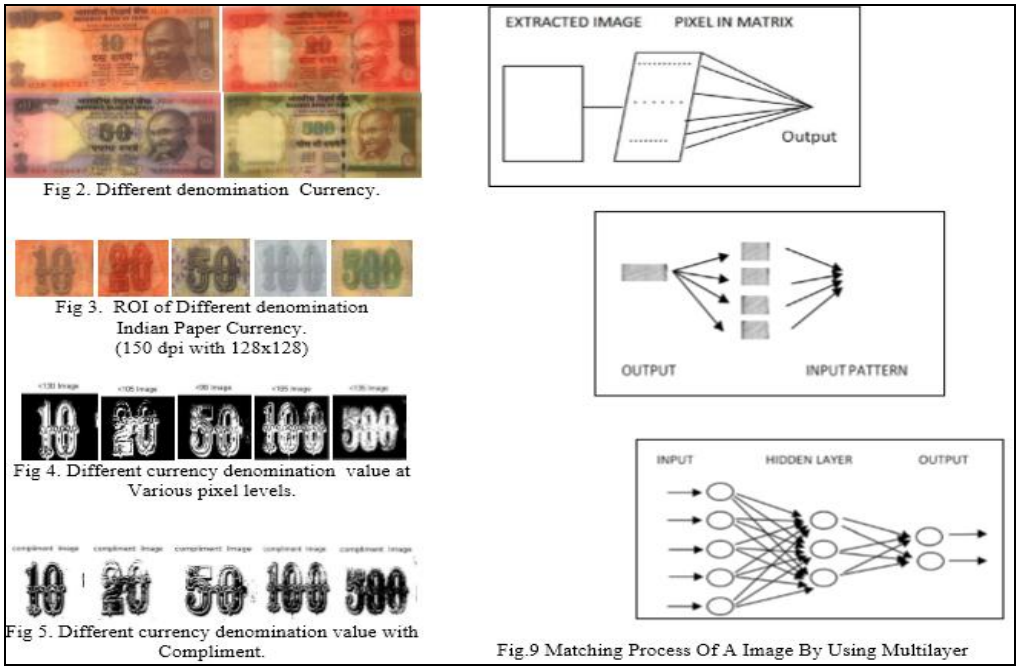

Fig 2: ROI and Denomination with matching technique [7]

The pattern recognition and neural networks technique is used for matching image pixels. The multilayer neural network match each pixel of given sample and provide the exact match.

5. Research Methodology

Indian currency denomination identification is done using digital image processing techniques/methods like:

1) RGB to Gray scale Conversion.
2) The process converts all pixels from RGB format to Gray scaled image. Gray scale image is obtained by taking average of R,G,B values of pixels.
3) Thresholding.
4) This process converts Gray scaled image to black and white image. Pixels have either have black color or white color depending upon threshold value.
5) Blurring.
6) This process helps remove any kind of noise from given input image. Noise removal is necessary to get more correct output.
7) Thinning.
8) Thinning is necessary to reduce pixel density to make processing simpler and realization of serial numbers.
9) Scanning.
10) Scanning jus scans all pixels and helps us finding the blobs.
11) Segmentation
12) Segmentation is needed in serial number extraction. Rectangular boxes are drawn around the character/ numbers are being extracted after thinning.
13) These methods are used in order to get more correct and efficient output. Pixels of images are processed with the help of these techniques.

6. Results & Discussion

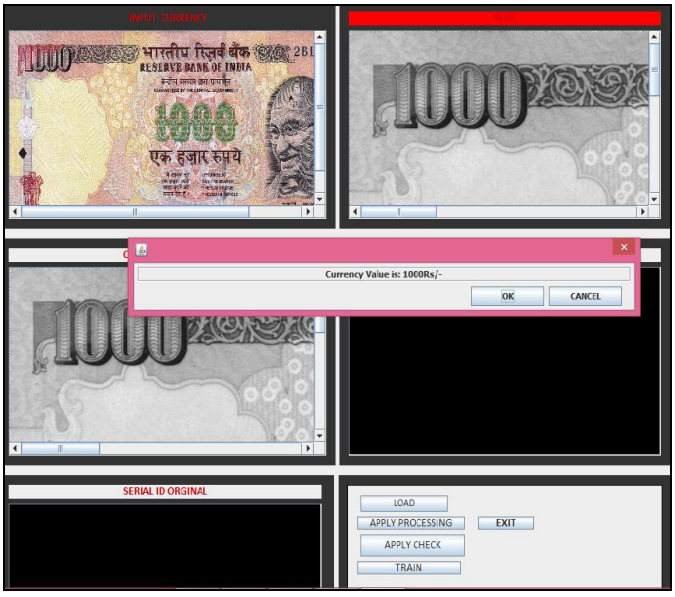

Fig 3: Identification of Denomination

The above fig shows that Currency's Denomination value is identified and it is displaying exact denomination value of input given of Indian currency.

Fig 4: Serial number extraction the above fig. shows that how

Indian currency gets processed and its Serial number is located on note, Cropped for display purpose. Blurred images are also displayed in two of the windows.

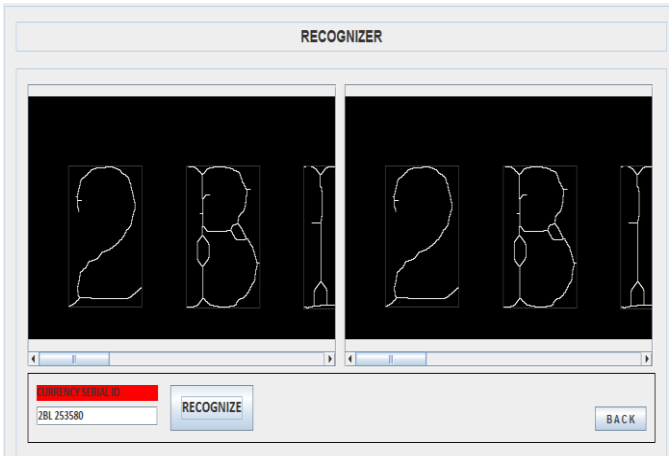

Fig 5: Serial number recognition (fake serial id)

The above fig. shows how Serial no is extracted from Indian currency. It is been shown in window. Red color is to show fake serial no of Indian Currency. Thinning process output is also shown.

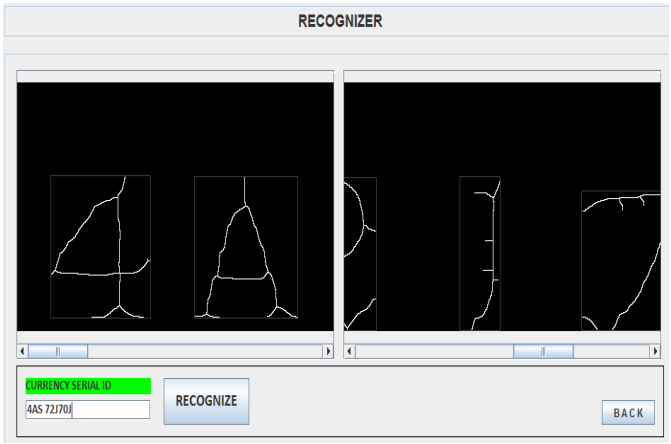

Fig 6: Serial number recognition (valid serial id)

This fig shows valid serial number is recognized from given input Indian currency.

The above snapshots of results are obtained when specific set of images are given as input and then all the processing is done. We have maintained the aspect ratio and length by width ratio in order to obtain output with more correctness and efficiency.

7. Future Work

Further development can be done on this project is to minimize the effort on to get perfect input currency image and make it faster and efficient with advance algorithms. There some limitation in extracting Serial numbers from certain denomination value currency due to less processed images. So there is much scope for more effective work on this project and this paper can be useful to do so.

8. Conclusion

This recognition method of Indian paper currency is quite simple, efficient and easy to be realized because denomination numerals are used for identification which can be extracted easily from paper currency. Such numerals are matched and are found exact match for identification. This Paper presented serial no. extraction method in very user friendly manner and as well system workflow diagram is quite easy to understand as well. In the end we can conclude that we have represented the way of recognizing denomination value and implemented serial number extraction with the help of Digital Image processing technique.

9. References

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