

Indian Rupee (INR) Currency Value Recognition Using Edge Detection and Pattern Matching Techniques

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Abstract: Currency denomination recognition is one the active research topics at present. There are many real-life applications which heavily use many techniques based on Pattern Recognition such as voice recognition, character recognition, handwriting recognition and face recognition. Paper currency recognition is a new application of pattern recognition. An efficient currency recognition system is vital for the automation in many sectors such as vending machine, railway ticket counter, banking system, shopping mall, currency exchange service etc. A successful approach for currency recognition depends upon feature extraction of that currency image. First the currency is scanned and preprocessing is done on input currency image. Then edge detection algorithm is applied to it. The purpose of edge detection in general is to reduce the amount of data in image, while preserving the structural properties for further use. The digits of currency like 10,20,50,100... are cropped, and the feature is extracted and stored in MATfile. If the features of test image is matched with that file, the software will return the class of that currency note. Experimental results are presented which show that this project can recognize Indian's Currency successfully with an average accuracy of 94.72%.

Keywords: pattern recognition, character recognition, feature extraction, Indian currency

1. INTRODUCTION

We live in an age of information where everyone is busy and life becoming faster day-by-day. In this busy life everyone needs complete and quick and correct response so they can save their time. Today's era is termed as the "IT age" or we can say it "Computer's Age" so it is thought inevitable to have software solutions for various problems in order to save the time, in different organizations despite of it whether, the organization is small or large enough. We focus to recognize paper currency accurately. Paper currency recognition is one of the applications of pattern recognition. There are some similar recognition systems, such as face recognition system, fingerprint recognition system. However the theories they use are similar but the techniques and approaches are different. The paper currency has different denominations, with each of them looking totally different. For instance the size of the paper is different, the same as an easy job. This may cause some problems (e.g. Wrong recognition), so they need an efficient and the exact system to help their work. As we mentioned before, the aim of our system is to help

people who need to recognize paper currency and work with convenience and efficiency. Otherwise our system is based on image processing techniques which include Noise removal, preprocessing in order to make the system more comprehensive. The main steps in the system are: Read image, reading the image we get from the scanner as well as the format of the image is JPEG. Preprocessing, removing noise. Feature extraction, comparison. Result. There are so many denominations of paper currency. Each note has different size and different color. This system is designed to reduce the human effort and to avoid the purchase of expensive hardware. This system will extract the features of the test image and will match with the features stored in training database. If the features match it will display the type of currency. There is no as such system for recognizing Paper Currency. This system can be used in: ATM Machines, Auto-Seller Machines, and Bank Money-Counters. The scope of the project is to recognize the paper currency note correctly and accurately. The main objectives of this are to develop an intelligent system for *Indian* paper currency that could recognize the currency note accurately. Commercial areas like the banks, malls, jewelry stores, etc have huge amount of transactions on a daily basis. Such places may be able to afford and find it feasible to buy machines that use UV light and other techniques to detect the authenticity of the currency. But for common people it is very difficult to just detect whether the currency is fake or genuine and they may face losses especially during bank deposits or transactions. This system is designed such that any person can use it easily and detect the authenticity of the currency he has by using the visual features of the currency . This system can further be converted into an app so that it is accessible to all the people. Furthermore, this system can be designed to detect currencies of other countries as well.

2. Literature survey

In [1], they did recognition by using neural network. The neural network is widely used for pattern recognition because of its abilities of self-organization, parallel processing and generalization. The neural network can recognize patterns effectively and robustly. In this they use a new kind of banknote Thai bank note as the object of recognition. In their recognition system masking process is defined as the characteristics extraction of a bank note image. Neural network learning and recognition algorithms implemented On DSP devices as a Neuron recognition engine; they proposed the continuous learning by the DSP unit which they have developed for banking machines.

In [2] they have worked for recognition of various kinds of paper currency. They proposed multiple kinds of paper currency with neural network using axis symmetrical

mask and two sensors. Mask extracts the characteristics of paper currency they used two sensors to get both images of currency surface. They construct an experimental system using a bank machine whose sensor is attached up side and down side. Finally they applied the proposed method to Euro currency.

In [3] they use symmetrical mask for recognizing paper currency. In this method non masked pixel value of banknotes is computed and feed to the neural network for recognizing paper currency. For this two sensors are used at the front and back of paper currency but decision is done by the image of the front. In next step paper currency. Each note has different size and different color. vectors for these parts.

In [4] the feature extraction of Indian currency notes involves the extraction of features of serial numbers of currency notes. Feature extraction means to extract the information from raw data which is relevant to classify to minimize the class pattern variability and enhancing the between class pattern variability during feature extraction, the dimensionality of data is reduced and it is needed due to technical limits and computational memory. Heuristic analysis of characters of the serial number is done. It is a technique which actually produces a good solution. anti-virus scanners use heuristic signatures to look for specific attributes and characteristics to detect virus. by using heuristics, time can be reduced when are solving problems .

In [5] they considered the distinctive point extraction and recognition algorithm for various kinds of banknotes By converting the scanned 256-colored image data to 4-bit gray data as pre-processing, we can get a better algorithm to find the dark areas on the special block because the dark color is robust to noise. By applying the continuous same colored area recognition algorithm to the face value of the banknote, we can extract distinctive data to classify the kind of banknotes, as the area is located in the different positions on each kind of banknotes. To recognize banknotes, we trained 5 neural networks. One is for inserting direction and the others are for the face value the distinctive data pattern according to the inserting direction shows relatively clearer tendency than that of the face value. With this method, we can get a high recognition rate except for 100 and 200 Euro bank notes. The proposed recognition algorithm does not include position correction.

In [7], as mentioned, no one can be 100 percent sure of the manual recognition and so the system was proposed to compare images of currency with the stored data and detect whether the currency is fake or genuine. This system used MATLAB to run and perform

the operations of the system. The feature extraction process mostly focuses on HSV values of the currency where the image is divided into blocks and the operations are performed on the ROI.

In [8], the survey paper proposes a system to improve the currency detection system especially in commercial areas like banks, shopping malls, etc. Here some different pre-processing techniques were mentioned such as Radiometric corrections and Geometric corrections for correcting spectral errors or distortions due to sensorEarth geometric variations etc. Different papers were compared and results were provided based on the accuracy rate obtained by using different methods.

In [9], a system is proposed to detect fake currency based on different features that can be extracted for comparison. Various methods are used at different stages histogram equalization, using feature vectors to stored extracted features, etc. The features that were used for currency detection were security thread, RBI micro-print and serial number detection.

3. System Architecture

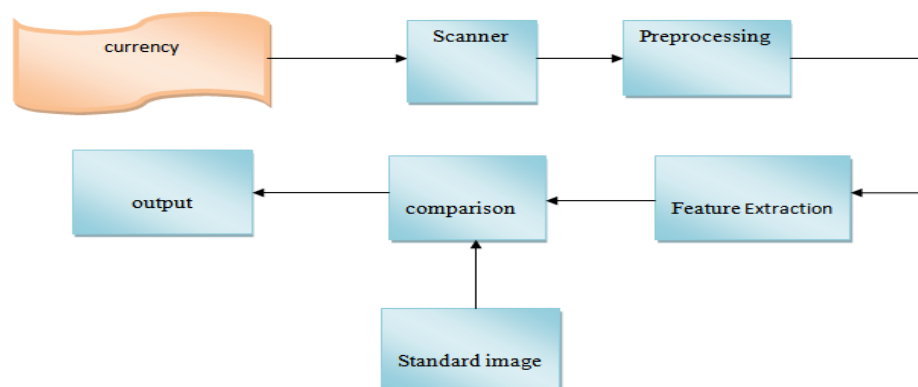


Figure 1: System Design.

Figure1 shows system design of Indian Currency Value Recognition , where currency is scanned by scanner and given as input to the system. Then following steps are done.

i) Preprocessing: The procedure is done before processing correcting image from different errors, is preprocessing. In this project the preprocessing techniques used are: i) convert the input image size into standard size. ii) conversion of RGB image to Gray. iii) Removal of Noise and iv)Extraction of edges of currency by Edge detection algorithm.

- **Conversion to Gray:** It represents an image as a matrix where every element has a value corresponding to how bright/dark the pixel at the corresponding position should be colored. It assigns value between 0 to 255 to represent the brightness of the pixel. 0 represents black and 255 represent white. We convert RGB color image into the gray level as color information is not useful in this recognition process furthermore it reduces the computational cost.
- **Noise Removing:** Many currency notes come with dust on them or something written on them. Noise removing is the process of removing such dust from these notes and makes the image clearer. MATLAB includes many noises The Wiener filter purpose is to reduce the amount of noise present in a signal by comparison with an estimation of the desired noiseless signal.
- **Edge detection :** It is a fundamental tool in image processing, particularly in the area of feature detection and extraction, which aims at identifying points in digital image at which the image brightness changes sharply. Here, the aim of edge detection is basically to localize the currency note that is the region of interest. For gray image Edge Detection algorithm is applied to get only edges of the paper currency. The purpose of edge detection in general is to reduce the amount of data in image, while preserving the structural properties for further use. After applying this algorithm the currency will look like as shown in Figure 2. This image format also stores an image as a matrix but can only color a pixel black or white (and nothing in between). It assigns a 0 for black and a 1 for white [6].

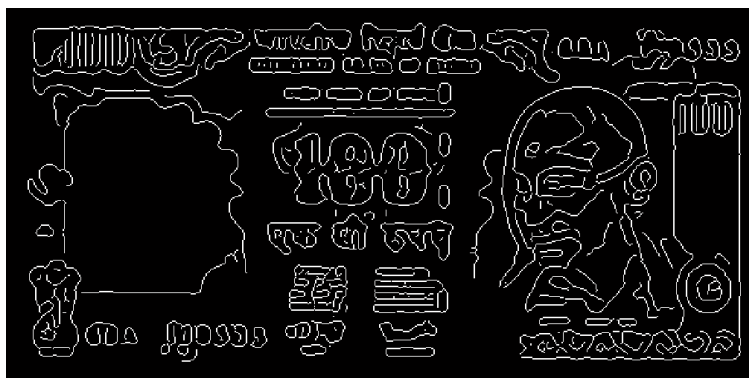


Figure 2: Edge detected currency image

Feature Extraction: In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set

will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. The following steps are done to extract the required pattern of image.

- The edge detected currency image (Figure 2) is cropped to get only the digits of the currency, which is the used to recognize the value of currency. The cropped image is shown in Figure 3(here the 100 rupee currency note is taken as example).



Figure 3: Cropped image

- Figure 3 has some discontinuous lines, these lines should be connected to get continuous pattern and to fill that portion with white color. This is done to fill the digits of currency, so that it is easy to identify the pattern. After doing this the currency will look as shown in Figure 4.



Figure 4: Pattern filled currency image

- Our aim is to extract the filled digits in Figure 4, to do this discontinuous lines are removed and only the digits are cropped. The final image is shown in Figure 5.



Figure 5: Required pattern

iii) Comparison : After extracting the required pattern from input currency image, it is compared with the standard pattern which is already stored in MATFile. Based on the percentage of match output is given. With which standard currency image the matching percentage is more that is given as output.

iv) Output : After comparison the output is displayed in message box.

For example give the input currency image of 100.Rs as shown in figure 6, the output is shown in Figure 7.

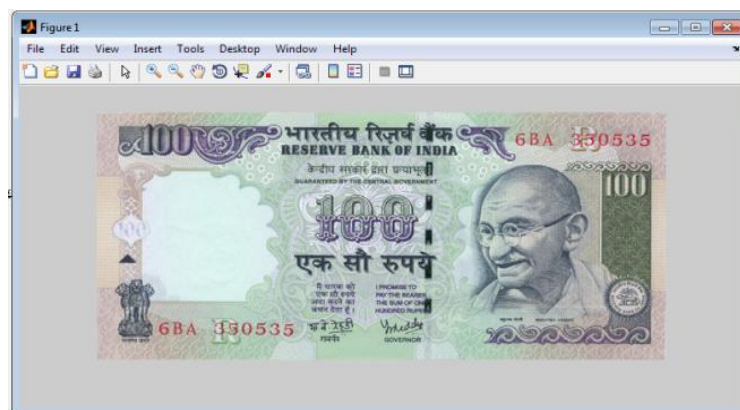


Figure6:Input currency image



Figure 7: Output

4. Conclusion

This paper shows the method for currency recognition using image processing. The proposed system uses the digits pattern as features of the currency for recognition. The process begins from image acquisition and end at comparison of features. The features are extracted using edge based segmentation and works well in the whole process with less computation time. The complete methodology works for Indian denomination 10, 20,50, 100, 500 and 1000. The method is very simple and easy to implement. If the hardware part of image acquisition is designed then it is surely help us to minimize the problem of counterfeiting currency. We had checked different notes on this system and the result is 94.72%. Later this can be enhanced with the efficiency in feature work.

5. Future work

The future work will be done to recognize fake Indian paper currency. To do this many features need to be extracted from currency, it includes identification mark, security thread, watermark and so on. Feature extraction and comparison can be done in the same way as we discussed in this paper.

6. References

- [1] Takeda, F., L. Sakoobunthu and H. Satou, 2003 " Thai bank note recognition using neural engineering systems" , Proceeding of 7th International Conference, KES 2003, Part I. Volume 2773 of Lecture Notes in Computer Science. Springer, Oxford, UK, September 3-5, pp: 1169-1177.
- [2] Debnath, K., S. Ahmed and M.D. Shahjahan, 2010, "A paper currency recognition system using negatively correlated neural network ensemble" J. Multimedia, 5(6): 560-567.
- [3] Guo, J., Y. Zhao and A. Cai, 2010, " A reliable method for paper currency recognition based on LBP", Proceedings of the 2nd IEEE International Conference on Network Infrastructure and Digital Content (IC-NIDC 2010). Beijing, pp: 359-363.
- [4] Singh, P., G. Krishan and S. Kotwal, 2011, " Image processing based heuristic analysis for enhanced currency recognition" . Int. J. Adv. Technol., 2(1): 82-89.

[5] Lee, J. and H. Kim, 2003. New recognition algorithm for various kinds of euro banknotes. Proceeding of the 29th Annual Conference of the IEEE Industrial Electronics Society (IECON '03), 3: 2266-2270.

[6] Kishan Chakraborty and Jordan Basumatary 2013, " Recent Developments in Paper Currency Recognition System ". IJRET: International Journal of Research in Engineering and Technology. eISSN: 2319-1163 | pISSN: 2321-7308.

[7] Eshita Pilia, Bhavika Arora, —Recognition of Fake Currency Based on Security Thread Feature of Currency International Journal Of Engineering And Computer Science, ISSN: 2319-7242.

[8] P. Julia Grace, Ph.D., A. Sheema, —A survey on Fake Indian Paper Currency Identification System Grace et al., International Journal of Advanced Research in Computer Science and Software Engineering 6(7), July- 2016, pp. 340-345 ISSN: 2277 128X

[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] Image segmentation techniques with output images [Online]. Available: <https://www.mathworks.com/discovery/image-segmentation.html>