

Recognition Of Indian Currency Note Using Grid Technique

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*Abstract-In recent years it has become a very essential to develop an automatic methods for paper currency recognition as its more likely to be used in most of the areas such as vending machines, shopping centers, educational sectors, banking systems- in case of huge transactions and so on. As the technology is growing fastly it has become more easy to use such systems. Now-a-days using automated machines any one can easily get to know whether the currency is a genuine or counterfeit and also the denomination of that currency. The technology has also provided a better way of life for peoples. There is a need to design a system that is helpful in recognition of paper currency notes with fast speed and in less time. This approach basically provides an easy method for recognizing the denomination of an Indian currency note. This proposed approach works on all the notes such as Rs.10, Rs.20, Rs.50, Rs.100, Rs.500, Rs.1000. Indian currency features such as extracting geometric shape, denomination object are extracted from a 4*4 grid of Indian currency image. Feature extraction plays an important role in successfully achieving value/ denomination of an Indian note. The approach consists of a number of components including image acquisition, converting RGB to HSV image, image pre-processing, Feature extraction, images are compared. The Artificial neural network is used to identify value / denomination of an Indian currency note.*

Keywords — Feature extraction, Indian Currency recognition, color features, neural network.

I. INTRODUCTION

Since from the ancient times gold, silver, copper and bronze coins were used as currency without any denomination till 6th century in India. Later on, in 18th century many banks originated and they started printing paper currency. In 1996, Mahatma Gandhi series of notes were introduced. Currency is a term which refers to intermediate of exchange. Each country possess its own currency. There are huge number of currencies in the world. The currency of India is Rupee. The First paper money was introduced by the Government of India in the year 1861 by issuing Rs.10 notes. In the year 1864, Rs. 20 note, Rs.5 in 1872, Rs.10,000 in 1899, Rs.100 in 1900, Rs.50 in 1907 and Rs.1000 in 1909. In present generation, India is having currency system as the Rs.5, Rs.10, Rs.20, Rs.50, Rs.100, Rs.500, and Rs.1000. Indian currency notes are having their own features such as face value of the banknote, shape, color; quality, texture etc. Visually disabled people also can identify the denomination of Indian currency based on special identification marks. At the top right end every Indian currency note has its fixed

denomination that one can feel by sensitive touch. But marker may gets fade after many the distribution of copies of a periodically among readers. It is very important to develop automatic system to extract feature and recognize Indian currency note it is important in various areas such as bus station, railway station, shopping malls, banking and ATM machines so that it could help the people especially for visually disabled peoples. In image processing, the potential features are extracted from Indian currency notes such as, identification mark and denomination object. So as to identify the denomination of that Indian currency.

Automatic Methods for paper currency denomination recognition have become very important in most of applications. The system is designed to recognize and verify the denomination of an Indian currency. The challenging task for system designers is the every year RBI faces the problem of counterfeit currency notes[4]. Every Indian bank note contains these features.

- **Optical Variable Ink** : The color of the number 500 appears green when the banknote is held flat but would change to blue when the banknote is held at an particular angle. The font size is also decreased.

- **Latent Image:** when keeping note at right angles to the vertical, the vertical band on the right shows an image of the number 500.
- **Security Thread:** The note also has a three millimeter wide security thread with the inscriptions: one thousand, the word 'Bharat' in Hindi and RBI.
- **Micro lettering:** The 'RBI' and the digit, "500" - which can be seen with the help of a magnifying glass - are between the Mahatma Gandhi portrait and the vertical band.
- **Watermark:** When the note is held opposite the light, the image of Gandhi and an electrolyte mark display the number 500 appear in the white region.
- **Identification mark :** An identification mark is being used in the Indian currency for the benefit of visually impaired people. They can identify the denomination based on the intaglio printing by a touch and it is having different geometrical shapes for various denominations, such as for Rs.20 having rectangle shape, Rs.50 having a square shape, Rs.100 having triangle shape, Rs.500 having circle and Rs.1000 having rhombus shape.
- **Fluorescence:** The unique number on the notes are printed from fluorescent ink. The banknotes are having optical fibers. They can be seen when viewed under a ultra violet light. A different and unique kind of font style is used. The numbers will be thick and written in red color.

In the proposed work ,Instead of dividing entire note into 3*3 grid[1] and to avoid extra noise that comes in extracting the features. Dividing the entire currency into 4*4 grid and extracting the features. Instead of applying only to the notes such as Rs.100, Rs.500, Rs.1000. Better to be applied on all notes such as Rs.10, Rs.20, Rs.50, Rs.100, Rs.500, Rs.1000 ,as they differ in geometric shape. Every single denomination has different geometric shape.

2. LITERATURE REVIEW

In[1],proposed "Grid Based Feature Extraction For The Recognition Of Indian Currency Notes ",The approach provides to identify the denomination of an Indian currency note using grid technique. The extraction of features from a 3*3 grid image makes possible to identify the value of a currency .Based on geometric shape, year of print, and denomination of currency the notes such as Rs.100, Rs.500, Rs.1000 are determined using neural network as a classifier.

In[2],proposed "Indian Currency Denomination Identification Using Image Processing Technique", The paper mainly provides an image processing technique to extract Indian paper currency denomination. The ROI is extracted and converting it into grayscale and setting up level. The Denomination value can be obtained by integrating the sobel edge filter, average filter and laplacian filter. The use of image processing techniques to identify specific region of interest and then applying neural network classifier and pattern

recognition techniques have been used to identify the denominations.

In[3],proposed "Recognition of Indian Paper Currency based on LBP", The paper makes use of local binary pattern(LBP) to extract the features and helps into recognizing the Indian currency denomination. The LBP operator is used on gray scale image and difference between original image and input image is carried out. The Euclidean distance is used as a classifier. The proposed algorithm has advantages of being simple and having high speed. The observed results show that this method has a high recognition rate. The recognition ratio can achieve 100% in case of good quality images

In [4], proposed "Recognition of Indian Currency Note Based on HSV Parameters", The paper basically allows to identify the image of Indian currency note is genuine or counterfeit. The RGB image is converted to HSV .The features are extracted by using histogram, hue, saturation, intensity/value. The histogram of input image is compared with saved images. If, threshold is greater than specified value then the image is considered as a genuine. Calculating the hue and saturation of given image and if threshold is less than the given image then it's a genuine. The neural network is used as a classifier. The above suggested approach works for all the Indian currencies.

In[5],proposed "Indian Currency Recognition and Verification System Using Image Processing", The paper helps us to identify the given image is genuine or not. It makes use of two features to identify i.e. identification mark and serial number. The RGB image is converted to gray scale and then edges are detected using sobel operator. The features are extracted from a segmented image and comparison is made .The count of black pixels from a segmented image matched then the currency is considered as a genuine. This technique is easy to implement in real word application.

3. PROPOSED ARCHITECTURE

The proposed work deals with implementation of an automated recognition system, which helps us to recognize the denomination of Indian Currency. The proposed system of recognizing the denomination of Indian currency notes is divided into different steps. The acquired image is first preprocessed by reducing the size of data dimensionalities and extracting its required features by using image processing tool box in MATLAB. Once the features are extracted then the neural network classifier is used to recognize and finally the result is obtained i.e. determines the denomination of the given input. The proposed data flow diagram is used to identify the value of an Indian currency. The work involves processing of different images of Indian currency and to recognize the denomination of the input image. Extracting the features from the input image, the RGB image is converted in HSV and totally 18 features are obtained , then image is divided into 4*4 grid to get specified features and to avoid unnecessary noise during the extraction phase. The geometric

shape from the (3,1) is calculated using pixel count value of the object and region props operation is applied to get the required object. Later on the other features are extracted from the from left top corner of the front side image and also from back side image (1,1) using the same region property as used as above. The extracted features are compared with a trained database and final result is obtained. If the given input image is of the both images front and back are of same denominations then it is matched or else back to take another time input.

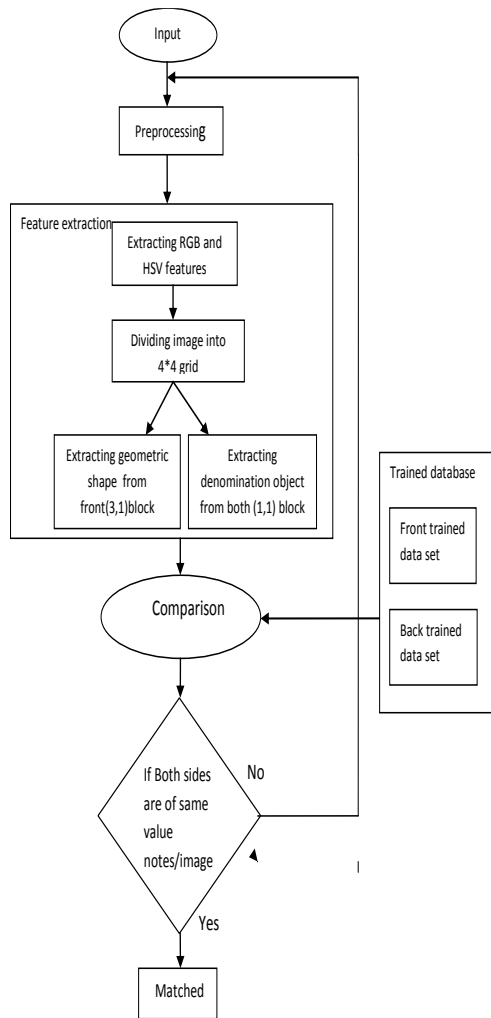


Fig 1 :DFD diagram for recognizing denomination of Indian currency notes.

3.1. Image preprocessing

The aim of image processing is to improve the image data and suppresses the undesired distortions or unwanted areas. These methods are classified according to the size of pixel, those are used for the calculation of new pixel. In the system we are resizing the image and then dividing into grid so that features can be more clear and extracted easily. The image features which are important for additional processing and study includes

Image adjusting: When the image is obtained from a camera or any other device the size of the obtained image is too big for the processing. In order to minimize the calculation the image size is reduced. The Captured images are resized to 200*400 pixels to reduce computational time. That occurs during processing of images. By resizing, the storage efficiency can also be improved.

Converting color image to gray scale: Note that only front images are converted to black, because in color image red, green, blue colors have same frequency from 0 to 255, hence it will create ambiguity in extraction as it is difficult to differentiate the colors using color code. When an color image is converted to gray scale then the whole image has the frequency from 0 to 255 hence it is easy to perform extraction. To convert color image to gray scale image MATLAB provides a function `b=rgb2gray(a)`, where a is a color image and this function converts that image to gray scale image and returns it into a another variable b.

Image Filtering : During the image transfers , some noise may be present on the image. Removal of the noise is an very important step to be performed. The presence of the noise may affect during extraction and segmentation or during matching. Filtering is a process of removing noise from the image for better results. MATLAB provides a function `bwareaopen(b,_)`, which take input black and white pixels and it contains two parameter first is an black and white image and second is an integer number, in an image if white pixels are grouped less than or equal to specified limit then all pixels are converted to black and it returns a filtered image. Later on it is stored in another variable.

3. 2. Proposed Algorithm

Algorithm: Detection Of Indian Currency Note Denomination

Input : Indian Currency Note in RGB image.

Output:

Recognition of Indian currency note denomination.

Step1: Indian Currency image in RGB.

Step2: Convert RGB image to HSV Image for both front and back images.

Step3: Only for front images convert HSV image to grayscale.

Step4: Apply 4*4 grid on each side of image.

Step5:Select the 3rd row 1st column i.e. (3,1) block from the grid of the front image to detect geometric shape as described in section 3.3.3.

Step 6: Apply bounding box to detected object present in the region.

Step7:Select (1,1) block from the front image and also back image to detect the denomination object using region property options (Area ,Major axis length, Minor axis length and Equiv diameter).as described in section 3.3.4.

Step8:Apply neural network classifier to determine whether the denomination is Rs 10,Rs 20,Rs 50, Rs 100, Rs 500, Rs 1000.

Step9:If both sides of image matched are of same denomination ,then denomination is detected.

Step10 :else repeat step 1.

4 . Feature Extraction

4. 1 Conversion of RGB to HSV

Color model is an arrangement of coordinate system, where in its subsection each color is denoted by a single color. The color model being used in the work are RGB and HSV. Color images are generally represented by Red , Green and Blue (RGB) values indicating combined response over RGB spectral bands which being measured through filters. The model is based on Cartesian coordinate system . The problem with the color model is the it produces color components that do not refer to the human visual system .The uniqueness used to differentiate from one color to other are Hue, Saturation and Value. Hue model is the ideal tool for developing image - processing algorithms. Hue and saturation are closely related to the way in which human beings describe HSV perception.

4.2 Geometric Shape

In the proposed work for the front images the unique feature i.e. geometric shape is extracted. It is extracted from the 3rd row 1st column of the front image. It is different for different denomination notes ,such as for Rs 20 it is rectangle shape, for Rs 50 it is square, for Rs 100 it is Triangle shape, Rs 500 it's a circle and for Rs 1000 it's a rhombus. Excluding Rs 10, its not having any shape in that specified block. The white pixel count in the particular area where object is present, is calculated. If pixel value in that particular block is less than the specified limit then it will be considered as white(i.e.255)or else if its greater then specified limit then considered as black(i.e.0).Suppose if any other object rather than required object is present in that area of interest whose value is less then assumed limit then it is removed using the Filter. Using the region props function the required object is obtained and bounding box to show the object and mark on it. An example showing how the geometric shape is obtained as shown in below Fig 2



Fig 2 : Displaying geometric shape of Rs.100

4.3 Denomination object

The object present in the block 1st row and 1st column of both the sides of image is called as denomination object. It is called so because the denomination of the note is written there. The region property options are used to calculate the Area, Major Axis Length, Minor Axis Length and Equiv diameter. Based on these extracted features compared with trained data set.



Fig 3:Extracted denomination object of front image



Fig 4: Extracted denomination object of back image.

5. RESULTS AND DISCUSSION

In the experiments ,we observed total of 300 images are taken in the data base, where in 150 are of back images and 150 of front images data set being used in this proposed method.BPN Feed Forward Neural Network is used for training, testing and validating of images.

The purpose of the Neural network classifier is to recognize the denomination of notes. In the experiment 20 images of Indian currency notes are taken for testing. This classifier offers better results in identifying the denomination of notes. In some cases it may not able to classify and recognize the denomination. The overall accuracy of the classification value is 94.1% approximately. Table 1.

Sl. No	Denomination Types	% of Images Correctly recognized	Recognition Rate(in %)
1	Rs.10	18/20	90%
2	Rs.20	19/20	95%
3	Rs.50	19/20	95%
4	Rs.100	19/20	95%
5	Rs.500	19/20	95%
6	Rs.1000	19/20	95%

Table 1: Results showing Total accuracy of the overall proposed work



Fig 5 : Front panel of software image is processed and denomination is recognized .

6. CONCLUSION

In this work, we proposed a model for recognizing the denomination of Indian currency note. It performs an efficient and quick recognition of Indian currency note using neural network. In this project we apply 4*4 grid and Geometric shape, denomination object from front image and also from the back image are used as features for extraction. It detects the denomination such as Rs 10, Rs 20, Rs 50, Rs 100, Rs 500, Rs 1000. The main objective is to develop an efficient method compared to the existing ones . A comparison of extracted features and trained features provides the result. It gives better results compared to existing systems in terms of time and accuracy. Proposed approach is experimented on our dataset and obtained 94.1 % recognition as success rate. By applying above mentioned methods we can say good results can be obtained quickly and correctly. The above proposed model is applied on large database and verified.

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