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Bank Cheque Identification and Classification using ANN

Savita Biradar[1], S.S.Panchal[2]

[1]Dept of CSE, B.L.D.E.A's CET, Vijayapura
savita.tb@gmail.com

[2]Assistant Professor, Dept of CSE, B.L.D.E.A's CET, Vijayapura
ssp058@gmail.com

Abstract*: Identifying bank cheques is one of the important task occurring in cash transactions, as banks receives huge number of different bank cheques every day from various account holders. For country like India, it is big hurdle. Identifying bank cheques, manually can be done but It is very time consuming. This paper presents the novel method for identification and classification process which can be efficiently done. The proposed approach works on a specific features of the Indian bank cheque and classify according to different banks. The recognition system is having three parts. First, The scanned image is processed by reducing size and extracting its features by considering 18 color features that is RGB(Red Green Blue), HSV(Hue Saturation Value). Second, Logo detection using Speeded Up Robust Features (SURF) point matching algorithm and extract region properties of logo and Third Classification of different bank cheques using neural network classifier. The Bank Cheque Identification and Classification system has given 91.43 accuracy.*

Keywords: Bank cheque, Logo detection, Feature Extraction, and ANN Classifier.

1. Introduction

Manual identification of all cheques in transactions is very time consuming and untidy process and also while handling, there is a chance of tearing cheques. Therefore automatic methods for bank cheque identification are required in many of applications like banking systems for withdraw money or a cheque is written in order to directing a bank to pay money and transferring money. Extracting sufficient characteristics from the cheque image is essential for accuracy and robustness of the automated system which identifies the Indian bank cheques. We have proposed method for cheques identification and classification technique by extracting features with RGB,HSV color space of cheque image(18 features) and region properties of logo(4 features). In this method, All cheque images are taken with the help of scanner(HP disk jet, all in one) .The scanned images are analyzed by extracting features and classification of different bank cheques using neural network classifier. Various methods are there for bank cheque verification and authentication using signature. Here, the proposed method is for bank cheque identification and classification based on RGB, HSV parameters and Region properties.

2. Literature Review

M. Jasmine Pemeena Priyadarsini et al. [1] proposed a system in which Bank Cheques can be classified and can be authenticate using signature. A system which flags the cheques that are to be impounded and also it go through cross pattern verification to acclaim the authoritative cheques. The aim of this system is to make verification of signatures size and angle invariant. Scaling and rotational manipulations on the target image is used to achieve the invariance. This system verifies a cheque by recognizing and analyzing the measure details in cheque, which includes account holders signature. It falls through image capturing, gray scale image conversation, binarization, Edge detection, segmentation, which is then localized & the signature is compared.

Pragati D. Pawar et al. [2] 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, and 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 note is a genuine. The neural network is used as a classifier. The above suggested approach works for all the Indian currencies.

Sangeeta Girish Narkhede et al. [3] proposed a modified version of shape context for signature verification of cheques by K-Nearest Neighbour classifier. It also give effective performance compared with existing methods for pattern matching system Local Binary Pattern. The Shape Context is nothing but feature descriptor which is used for recognition of objects. It describes the coarse distribution of the remaining shape according to the given point on spane. In this system author used some of properties like translation, scaling, variation and rotation. If this system is

used for signature verification it would be time consuming task.

Guangyu Zhu et al. [4] defined graphics detection and recognition are fundamental research problems in document image analysis and retrieval. As one of the most pervasive graphical elements in business and government documents, logos may enable immediate identification of organizational entities and serve extensively as a declaration of a document's source and ownership. In this work, he developed an automatic logo-based document image retrieval system that handles:

1) Logo detection and segmentation by boosting a cascade of classifiers across multiple image scales; and

2) Logo matching using translation, scale, and rotation invariant shape descriptors and matching algorithms. This approach is layout independent and they address logo retrieval in an unconstrained setting of 2-D feature point matching.

Jyoti Bhalla et al. [5] Describes the study of the use of distinctive anatomical biometric characteristics for signature which automatically recognizing individuals. They proposed verification method for online signature using Principle Component Analysis (PCA) and Artificial Neural Network. Author used PCA to extract features which are for training the network. In this system, verification part includes giving the extracted features of test signature to a trained neural network that will classify it as a genuine or forged. From this paper we refer artificial neural network to classify the bank cheques.

Mukta Rao et al. [6] implemented an automated system for Authentication of Bank Cheque Signatures using Recurrent Neural Network. Author described an optimization relaxation approach which is based on Hopfield Neural Network (HNN) or recurrent network. In this approach customer's sample signature is cross matched with one supplied on the cheque . Next the various percentage is obtained by calculating the different pixels of both images. The used network is built in such a way tha each pixel of different image is a neuron in network. These neuron is differentiated by its states, if particular pixel is changed. The network converges to an wavering condition according to energy function that is calculated in experiments. The HNN enables each node to take of 2 binary state values for each pixel (changed/unchanged). The performance of this system is evaluated based on different binary and gray scale images.

K.A.Vala1 et al. [7] proposed a system that performs Off-line Signature Recognition and Verification. Which is used to recognize and verify handwritten signature of individual's. This system provides authorization in business and financial transaction. So, as the demand for processing of identification of individual faster and accurately, the automatic signature system is required. This paper presents a brief survey for various off-line signature recognition and verification system. In this paper also differentiate between off-line verification and on-line verification. The off-line verification method is performed off-line there the hardware signature of individual are acquired by scanner. The scanned signature is used for verification task. The on-line verification method is performed on-line, where the signatures are acquired by touch screen, stylus and digitizer. The device generates dynamic values- location, signature's speed, pressure of pen, co-ordinate values, signature's time etc.

Dr. Ajit Danti et al. [8] 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. As they used segmentation after dividing an image into 3*3 grids.

As explained in literature survey some of the author used segmentation, for the proposed system that is Bank Cheque Identification and Classification using ANN if we used segmentation for logo detection, we don't get exact logo. This is because after converting cheque image into gray scale image some of cheque logos will not appeared clearly such as ICICI and CANARA bank cheque. Therefore we used Speeded Up Robust Features (SURF) Point matching Algorithm to detect logo from cheque.

3. Methodology

The system for bank cheque identification is divided into different parts. As shown in the figure 1, the scanned image is first pre-processed by reducing data dimensionalities and features are extracting by using image processing, according to the color space and region properties. Finally classification of different bank cheques using neural network classifier.

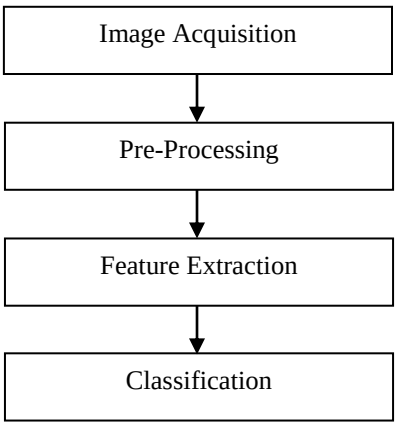

Figure 1: Block Diagram for Bank cheque Identification

Image acquisition: The image is acquired with the help of scanner. The main of this is that acquired image should contain all the features.

Pre-Processing: The image is to be processed should be put in the format that is appropriate for digital computing. This includes transformation of image from one format into other that is RGB to gray scale image. It also involves image resizing.

Feature Extraction: It involves the different features extraction that are present on the cheques. Feature extraction can be done by analyzing its color(RGB), hue, saturation and intensity/value (HSV) color space and Region properties.

Classification: After getting cheque features, it is essential to identify the which bank cheque it is on the bases of these features. That should be practiced by an effective identification system called classifier. A Neural network based classification scheme is used here for bank cheque identification .A multi-layered perception is a kind of forward neural networks which is well known tool for pattern identification.

3.1 Detailed design.

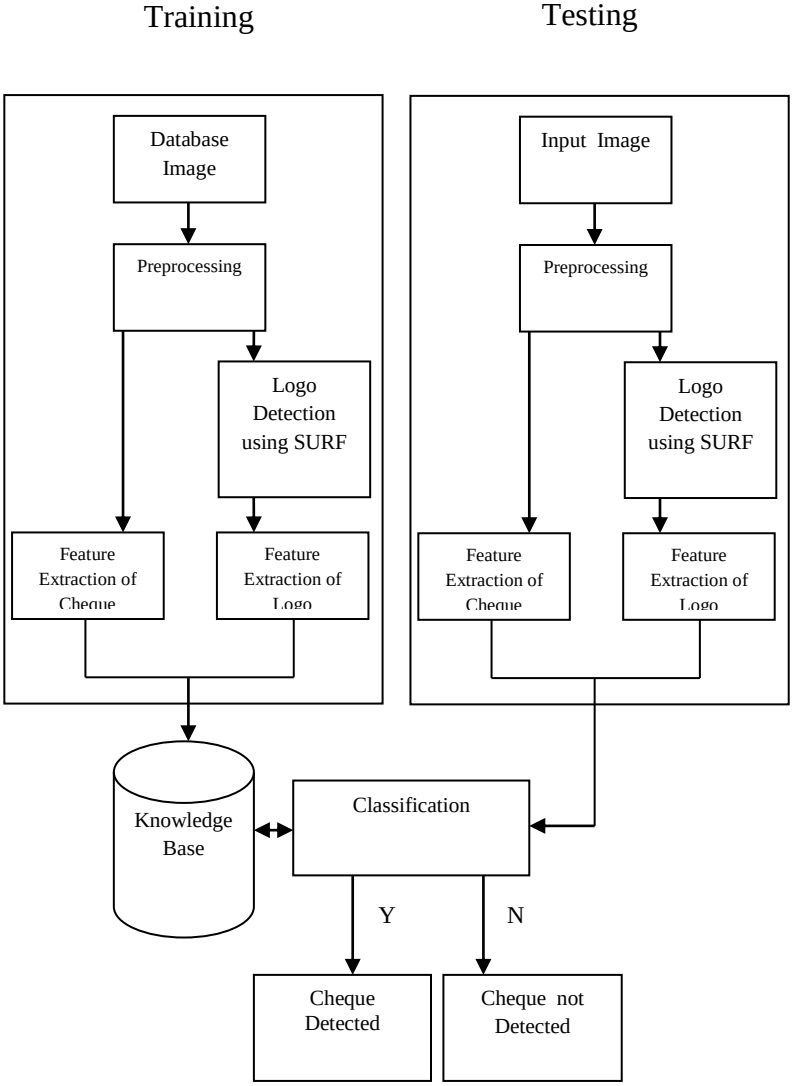

Figure 2: Detailed design of Bank Cheque Identification and classification.

Figure 2 shows the framework of our Bank Cheque Identification and classification system. Here before testing the training of database images has to be carried out using Artificial Neural Network(ANN) which is called feed forward back propagation neural network.

Database:

For the proposed system, the database is created with 350 images of 7 different bank cheques (SBI, SBH, CANARA, ING, ICICI, IDBI and VIJAYA). 50 images for each bank cheque. All images are taken with the help of scanner(HP Diskjet, all in one).

Preprocessing: In this step,

1. Images are resized to 200 X 500 because while scanning the images are not in proper size.
2. RGB images are converted to HSV images.

Feature Extraction of cheque:

The features are necessary for differentiating one class of objects from another. A method must be used for describing the objects so that features of interest are highlighted. In this step, as listed in the table 1. Extracting 18 color feature of cheque image called statistical features such as Mean, Variance and Range of color spaces RGB and HSV.

Color Features:

RGB space or color space is a widely used for displaying a image. It is defined by three color components such as red, green, and blue. These three components are said to be a "additive primaries" usually color in RGB space is displayed by adding them together. According to cyan-magenta-yellow (CMY) space is a color space which are used for printing. The three color components cyan, magenta, and yellow are called "subtractive primaries". The color in CMY space is produced by light absorption. The RGB and CMY space are non-uniform and device-dependent. The RGB mean, variance, and range are computed using the following expressions:

Mean $m=\sum_{i=0}^{L-1} zi\ P(zi)$ *1*

Standard deviation $\sigma = \mu 2(z)$ 2

Variance $= \sigma\ x\ \sigma$ *3*

Maximum element and minimum elements from given input image

$max1=max(image),\ max2=max(max1)$ 4

$min1 =min(image),\ min2=min(min1)$ 5

The above functions returns the row vector containing maximum element from each column, similarly find minimum element from whole matrix.

Range is the difference between the maximum and minimum elements.

Range $= max2\text{-}min2$ 6

HSV space is used in computer graphics and it is a more general way of describing color. Among These three color components are hue, saturation and value or intensity. The hue is invariant to the change in illumination and camera direction and therefore it is more suitable to object retrieval from the particular image . RGB coordinates can be easily translated to the HSV coordinates .

H (hue) shows colors, such as red, orange, yellow, green, cyan, blue and magenta

S (saturation) represents how much the number of white lights mixed with a hue.

V (value) describes the brightness of a color..

Table 1: Eighteen Color Features

SI.NO	*Feature*	*SI.NO*	*Feature*	*SI.NO*	*Feature*
1	Red mean	7	Blue mean	13	Saturation mean
2	Red variance	8	Blue variance	14	Saturation variance
3	Red range	9	Blue range	15	Saturation range
4	Green mean	10	Hue mean	16	Value mean
5	Green variance	11	Hue variance	17	Value variance
6	Green range	12	Hue range	18	Value range

Logo Detection:

In this method, Logo is detected by Speeded Up Robust Features (SURF) Point matching Algorithm[4][10]. For logo detection, we also maintain a logo database[11][12] which is created with 7 logo images. SURF is a detector of robust local feature that can be used for tasks such as recognition of object or reconstruction of 3D and it also used to get a particular object from the image. SURF is based on an efficient use of integral images. SURF is used to identify scale-invariant points or point values from a particular image.

The integral image is defined as: From the original image, the detected image for example logo on the cheque image which is marked with a rectangle, that image can be evaluated quickly using the integral image.

SURF, for points of interest in images it is also called to be a detector and a high-performance descriptor. Where, the image is transformed into coordinates, using a technique called multi-resolution. It is also used to make a copy of the original image with Laplacian Pyramid shape and to get image with the same size but with less bandwidth. Thus the SURF specifies the points of interest are scale invariant. An algorithm to detect the logo is given below.

Algorithm: SURF**(Speeded Up Robust Features)** Point matching.

Input: 1. Cheque Image
2. Logo Image

Output: Logo.

Steps

Step 1: Convert cheque and logo images into gray scale images.

Step 2: Point the object of both images.

Step 3: Get the point values(features) of marked objects from both cheque and logo images.

Step 4: Match the point values of both cheque and logo images.

Step 5: If object points of logo are matched with object points of cheque then, mark and crop that part from the cheque image.

Step 6: Else logo not detected.

(a) (b)

Figure 3: (a) Logo image and (b) Cheque image

(a) (b)

Figure 4: (a) Pointing objects of logo and (b) pointing objects of cheque image.

Figure 5: Logo detected.

The SURF point matching algorithm works as follows:

- First we give Logo and Cheque image as a input as shown in figure 3.
- Point the objects of logo image and cheque image as shown in figure 4.
- Extract the strongest features or point values from images shown in figure 4.
- Compare these point values of both the images. If matched, that region of interest(logo) is marked as shown in figure 5.

Feature Extraction of Logo:

After detecting the logo, the next step is extracting region properties[9] of logo such as Area, ConvexArea, FilledArea and Perimeter.

1. Area: Returns a scalar that specifies the actual number of pixels in the region. (This value might differ slightly from the value returned by bwarea, which weights different patterns of pixels differently)

2. ConvexArea: Returns a *p*-by-2 matrix that specifies the smallest convex polygon that can contain the region. Each row of the matrix contains the *x*- and *y*-coordinates of one vertex of the polygon. Only supported for 2-D label matrices.

3. FilledArea: Returns a scalar that specifies the number of on pixels in FilledImage.

4. Perimeter: Returns a scalar that specifies the distance around the boundary of the region. regionprops computes the perimeter by calculating the distance between each adjoining pair of pixels around the border of the region. If the image contains discontiguous regions, regionprops returns unexpected results.

Classification:

The classification is carried out using only one type of feature set that consists of all 22 features that are 18 color features and 4 region properties. The output layer consists of 7 nodes represented in binary digits. The output pattern is given in table 2 for identification of bank cheque.

Table 2: Output Pattern for Identification.

Bank Name	*Output Pattern*
ICICI	001
CANARA	010
IDBI	011
ING VYSYA	100
SBH	101
VIJAYA	110
SBI	111

4. Experimental results

In the experiments ,we have a database with 350 cheque images of 7 different banks, where 50 images for each bank cheque.BPN Feed Forward Neural Network is used for training, testing and validating of images. The purpose of the Neural network classifier is to identify and classify the denomination of notes.

4.1 Performance parameters:

- **Accuracy:**

The accuracy is given by the ratio of number of correct images by total number of testing images.

$$\text{Accuracy} = \frac{No\ of\ correct\ images}{Total\ No\ of\ testing\ images} \text{ X } 100$$

- **FAR(Fault Acceptance Ratio):**

The false acceptance ratio is given by the number of wrong images accepted by the system as the correct cheque images.

$$\text{FAR} = \frac{No.\ of\ wrong\ cheques\ accepted}{Total\ No.of\ wrong\ cheques} \text{ X } 100$$

- **FRR(Fault Rejection Ratio):**

The FRR is given by the total number of correct cheques rejected by the system .

$$\text{FRR} = \frac{No.of\ correct\ cheques\ rejected}{Total\ No.of\ correct\ chequesd} \text{ X } 100$$

To test the performance of proposed system, we evaluate the system with respect three performance parameters accuracy, FAR and FRR are tabulated in table 4.1. In the experiments, 15 images are randomly selected as queries(testing images) for each 7 banks. As shown in table 3 result of the proposed system gives different accuracy in classifying the different bank cheques. The accuracy of classification using 22 features sets for each bank cheque gives above 86% and below 93%. It gives 0% as fault acceptance ratio because this system does not accept any fault or wrong images. The table 4 shows overall accuracy of the system is 91.43% and overall FRR is 8.57%

Table 3: Analysis of the Identification and classification System

BANK	*ACCURACY*	*FAR*	*FRR*
ICICI	93%	0%	7%
CANARA	86%	0%	14%
IDBI	93%	0%	7%
ING	86%	0%	14%
SBH	93%	0%	7%
VIJAYA	93%	0%	7%
SBI	93%	0%	7%

Table 4: Overall Result of the System

BANK	*ACCURACY*	*FAR*	*FRR*
7 Bank Cheques	91.43%	0%	8.57%

5. Conclusion

With development of modern banking services, automatic methods for bank cheque identification become important in many applications such as banking system for withdraw money or a cheque is written in order directing a bank to pay money and transferring money. The technology of bank cheque identification aims to search and extract the Color features and Region properties from cheque for efficient classification. This is the bank cheque identification system for classifying Indian bank cheques. The system has a good performance for classifying bank cheque according to different Indian Banks (Nationalized Banks).

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Author Profile

Savita Biradar received B.E in computer science and engineering from BLDEA's Dr.P.G.Halakatti college of Engineering and Technology, Vijayapura and pursuing M.Tech in computer science and engineering in BLDEA's Dr.P.G.Halakatti college of Engineering and Technology, Vijayapura.

Prof .S.S Panchal received B.E in computer science and engineering from BLDEA's Dr.P.G.Halakatti college of Engineering and Technology, Vijayapura and M.Tech in Computer Science and Engineering from Basaveshwar College of Engineering and Ttechnology , Bagalkot