



Bank Cheque Authentication using Signature

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Abstract— Signing documents is something that most everyone is familiar . In our daily lives we sign everything from personal checks to birthday cards. So it is necessary to determine the authenticity and genuineness which require certification using signatures. Most signature verification schemes till date have required perfect alignment of the signature to the specified axes. However there are situations when the sample to be verified may not be aligned to the required axis. In that situation the current verification schemes could reject the signature even though it may be genuine. Though various techniques are available for verification of cheques before Clearing, there are possibilities of unavoidable errors. Inconsistent handwritten Character's pattern & alignment errors. In order to avoid this, a system that not only flags the cheques to be impounded, but also take it through cross-pattern verification to acclaim the authoritative cheques. The suggested technique aims to make the verification of signatures size and angle invariant. The invariance can be achieved by scaling and rotational manipulations on the target image. We propose a methodology that verifies a cheque by recognizing and analyzing the major details in a cheque, which includes the account holder's signature. It falls through image capturing, gray scale image conversion, Binarization, Edge detection, which is then localized & the signature is compared. Image captured is converted into a gray scale image which resolute the authoritative regions in the cheque that includes the account bearer's signature. The contour classification ensures the segmentation of the characters on the cheque. It is then localized, and compared with the account holder's source of information and clarified and passed on. Any checks that are not successfully read and matched are highlighted as an exception and immediately forwarded to the client for further action.

Keywords— Bank cheque, Area of Interest (AOI), Edge detection , Sobel filter.

I. INTRODUCTION

Hand written documents are the most reliable source, from documentation to identify an individual's identity. But the increase in technologies together booms the chances of fraudulent in all fields. One among such unlawful criminal acts is the cheque forgery [1]. A cheque is a written order directing a bank to pay money or to withdraw money. This medium of service can be easily intervened and cheated, when the modes of verification are insecure and dumb. Cheque fraud is accelerating as a world-wide problem with a huge amount of loses to the nation. It appears that a fraud cheque clears through most of the banks every day. It is an irony from the fact, that the advancements in the technology sophisticate the banking sector fraudulency. Account bearer's cheque is generally provided with watermarks, holograms, security threads and special paper to avoid the possibilities of counterfeit the bearer's cheque. In spite of the increased safety, their increase in use has led to various scams. Even the cashiers at the bank are trained to vigilantly examine the cheques details and clarifying it with the recorded information. But all these effects bring out a new bank robbing measures by the counterfeiter. Various other techniques have been evolved in the recent decades as internet based systems that verifies the cheques. We propose the technique that verifies the cheque based on stored information to accept the cheque or reject it and re-scrutinizes it, if necessary before sanctioning the amount to the payee. An alert has been generated in case the machine comes by any bugs. In this paper, we propose a method to verify bank cheques by using account holder's signature present on the cheque image. It involves feature extraction from the cheque image & comparing with the edge detected image in the database.

The input image is converted in to grey scale image followed by Binarization. The binary image what we get is a result of Threshold. Thresholding is a simple, non-contextual, efficient segmentation technique. Localization is done to recognize & locate the active region of interests. Slant correction is done to improve segmentation and recognition accuracy for handwritten signature. Then finally we are comparing the edge detected image to the image in the database.

II. SIGNATURE VERIFICATION METHODS

Hand written documents are the most reliable source, from documentation to the individual's identity [1] [2]. So, it is necessary to verify the signature before sanctioning the amount to the payee. There are two kinds of signature analysis schemes.

- Offline methods
- Online methods

Offline methods

Offline methods use static information's for verifying the signature. Offline signature schemes use the signature as the input image and are used in the verification of bank cheques. Offline signatures usually have noise present in them. So, it is necessary to apply filters to remove the noise from the signature after processing the input image.

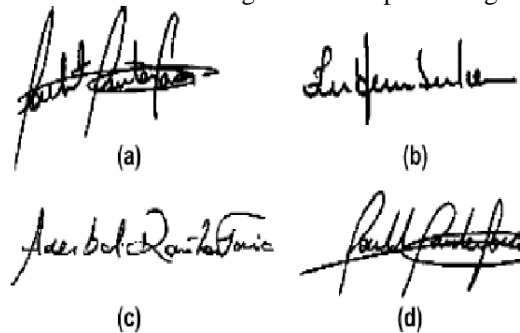


Fig. 1. Offline Methods

Online methods

Online methods use dynamic information's for verifying the signature [1]. Online signature methods are usually carried with the help of devices like pressure-sensitive tablets and webcam that extracts features from a signature. They are employed in real-time applications for eliminating fraud. They are used in computers for accessing sensitive data, Forensic applications and in credit card transactions. Online signature methods have high accuracy and are very cheap to implement.



Fig.2 Online Methods

Types of signature forgeries

There are several different types of signature Forgery and they are as follows [2].

- Simulation Forgery
- Tracing Forgery
- Cut and paste Forgery[*some numbers should be assigned*]
- Electronic Forgery
- Free hand Forgery

Simulation Forgery

In Simulation forgery, the forgery is done by making copies of the genuine signatures. These signatures can be identified by inspecting the writing looks and line quality of the genuine signature.

Tracing Forgery

In tracing, the forgery is done by holding the genuine signature under a light source or carbon paper. These forgeries have indentation in the paper underneath the signature.

Electronic Forgery

An electronic forgery involves scanning a genuine signature at high resolution then inserts it to a document. These signatures do not possess a trace of ball pen and will only show color dots.

Cut and paste Forgery

The genuine signature is cut from a genuine document and placed it another one, then photocopied. With proper adjustments and lightning, the forged document will look genuine

Free hand Forgery

In free hand forgery, it is done by simply writing the victim's name without any errors.

Things to look at:

- Chemical/physical eraser below the signature
- If signature lacks flow, rhythm or speed
- Spell errors in signature

- Signature executed in a thick pen.
- Signatory of signer is different.
- If slant of the signature is different to the genuine one.

By inspecting these things carefully we can reduce signature forgery in most of the cases. In other cases, we need to go for a verification method to find out the genuine signature.

III. PRE-PROCESSING TECHNIQUES

The pre-processing steps are necessary to improve the performance and also to transform the input cheque to a standard format.

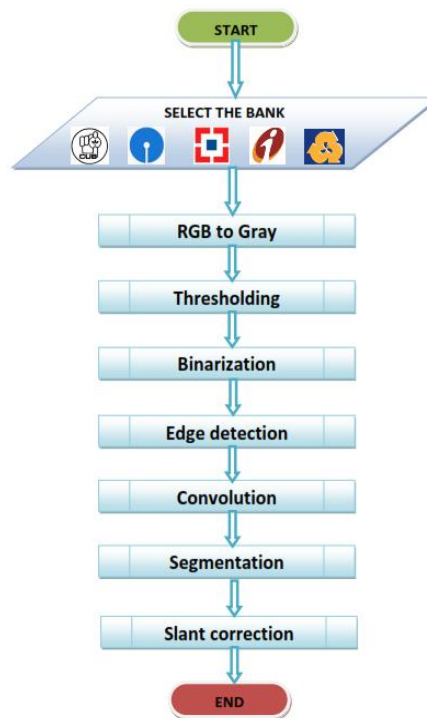


Fig.3 Pre-processing Techniques

Cheques Database

A first step towards collecting a database is to find real world source of data. We collected five cheque books of different banks. Each cheque leaves were signed by different individuals, totally 100 cheque leaves was collected for our database [3]. All the collected cheques were scanned and stored in a digital format. There will be some amount of noise in the cheques which might be added during folding or handling of cheques. We used median filter to remove the external noises present in the cheque leaves.

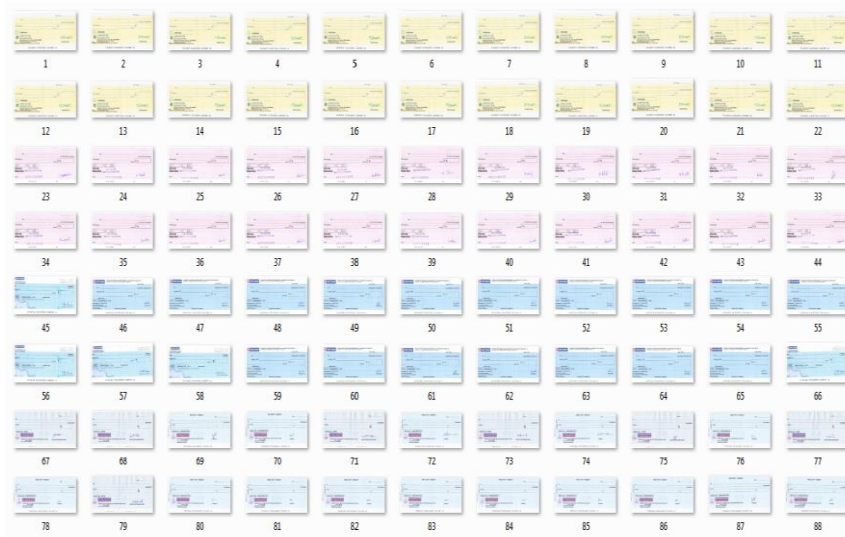


Fig.4 Cheque Database

Gray-scale conversion

The input image is converted in to shade of grey by implying the predefined user function in matlab.

1. The input cheque might have a variety of color strain, which is very difficult to compare and verify.
2. To reduce the size of the cheque image.
3. To maintain uniformity across all pixels.
4. For locating the area of interest.
5. It is very easy to process gray-scale image.

Binarization

There are 256 gray levels of a gray scale image. We need a binarized image having only white and black values. Each pixel is stored as a single bit (0 or 1). To do so, we need to go for thresholding. We can take any threshold value depending on our input cheque. The threshold value is calculated by implying the pre-defined matlab function. The binary image what we get is an result of thresholding

Segmentation and Localization

We segment an image in-order to transform in to a more meaningful form, so that it will be easy for us to analyze. In segmentation, we partition the input cheque in to multiple regions. Segmentation will stop, once the account holder's signature is isolated from the input cheque. After segmenting the image, we can locate our Area of Interest (AROI). Locating the AROI is a complex task as far as cheque image is concerned [5]. Once we determine the possible area of the signature by scanning the image vertically and horizontally. We expect the cheque to have a maximum number of dark spots. Therefore, we find and store the area that contains the most lusters. Thus, we were able to locate the signature from the cheque image.

Edge Detection

Edge detection helps in maintaining the important structural property of an image and helps in removing the useless information. Perhaps, Edge detection is important in pattern recognition and image processing. It is the forefront for processing image in object detection. Edge detection helps us in separating the from the bank cheque.

Normalization

The extracted image maybe out of sync in relation to rotation. Incorrect image rotation is very likely to turn the distorting that features that are extracted. In order to avoid that, we go for Normalization. In Normalization, we perform slant correction, thinning and thickening of the image. We go for thinning to eliminate the thickness differences & we thicken the image to maintain uniformity in thickness.

IV. GLOBAL FEATURES

Global features are obtained after the Normalization process [6].

Image are:

It shows the number of black pixels in the image. It measures the density of the signature in a image. The total area of the signature in the image is calculated by the summing of the number of white pixels in each column. This is the pixel area of the signature.

Baseline shift

It is difference in the vertical centre of gravities between the left and right halves of the image, is used for the slant variation due to overall orientation of the signature [4].

Vertical center of the signature

Centre x is the vertical centre of the gravity (calculating the centre of mass of the X coordinate of the signature)

Horizontal centre of the signature

Centre y is the horizontal centre of the gravity (calculating the centre of mass of the Y coordinate of the signature).

Maximum vertical and the horizontal projections

The maximum values of the horizontal and the vertical projections of the image histogram is taken as the maximum vertical and the horizontal positions respectively

Slant Correction:

Slant correction is a technique to improve segmentation and recognition accuracy for handwritten signature. The handwritten signature is not constant. The average slant angle of word is estimated and then corrected uniformly by shear transformation [6]. So, that the signature looks constant over the particular area of our interest.

V. PROGRAMMING METHODOLOGIES

Block diagram of the verification system

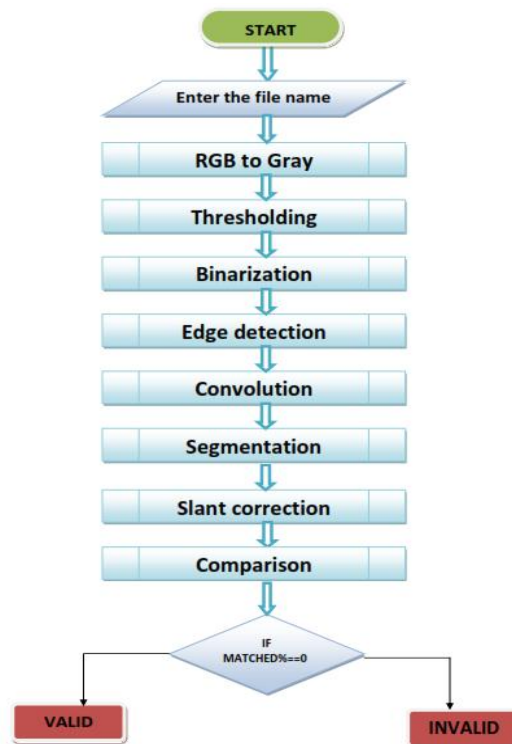


Fig.5 Block diagram of the verification system

Input image:

The cheque that needs to be verified by the system is given as the input image. You will be given with the choice of choosing the cheque of your choice.

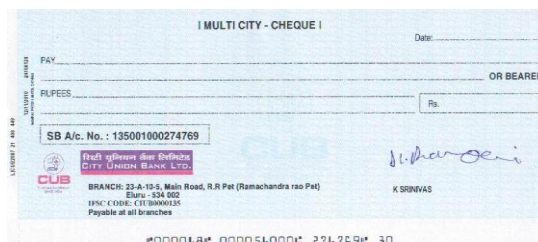


Fig.6 Input Image

Obtaining the grey scale image:

The input cheque might have a variety of color strain, which is very difficult to compare and verify. To reduce the size of the image and to maintain uniformity in all images, the input image is converted in to shade of grey by using the command `rgb2gray(I)`. Where I is the input image.

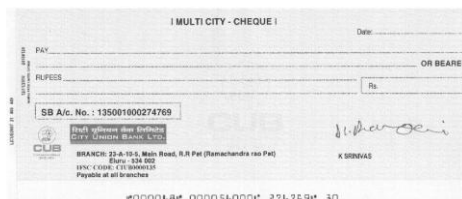


Fig.7 Gray Scale Converted Image

Thresholding and Binarization

Thresholding is the major part of the image segmentation, where we can isolate the objects from the back ground. An image is turned into binary image (which contains 0's and 1's) by choosing a threshold value [7]. The threshold value depends on the input image that we give; each cheque will have different threshold value depending on the intensity and resolution of the input image. Thus threshold value is chosen for a gray scaled image and then turning every pixel into black and white according to whether the gray value is greater than or less than the threshold

- A pixel becomes white if gray level greater than threshold
- A pixel becomes black if gray level is less than or equal to the threshold

By using the following command, thresholding is fixed using matlab,

```
Level =graythresh(IMAGE)
Im=im2bw(IMAGE,Level)
```

Where level is the value between 0 and 1

The command will work for the gray scaled, colored and indexed images of the data type unit 16, unit 8 and double.

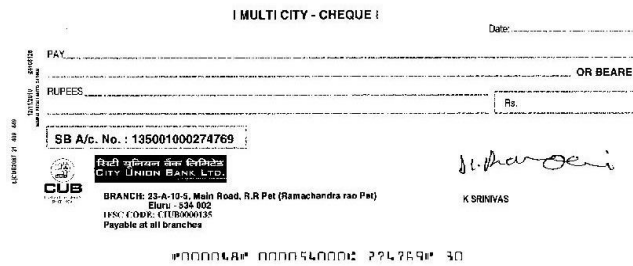


Fig.8 Binarized Image

Edge detection [2]

Edge detection is done to maintain the most useful information in an image and to isolate some of the unwanted information in the background of an image [8][9]. There are many number of edge detection algorithms. In our paper we used 'sobel' filter for the edge detection of an image.

Sobel filter

The Sobel filter has a smoothing effect, so they're less affected to noise [2]. Sobel filter also helps us to detect edges by applying a horizontal and vertical filter in sequence. Both filters are applied to the image and summed to form the final result. Thus, by applying the sobel filter we are able to locate account holders signature in a cheque image [2].

-1	-2	-1	-1	0	1
0	0	0	-2	0	2
1	2	1	-1	0	1
Horizontal			Vertical		

Fig.9. Sobel Edge Operator

By using the following command, edge detection is done in matlab

```
Edge (image,'method', parameters)
```



Fig.10 Edge detected Image

Convolution

Convolution is done to increase the intensity of an image because when edge detection is done the image may lose some of the useful information, which may use for the feature extraction so by increasing the intensity of the edge detected image is increased ,so that we can increase the accuracy.

This can be done by taking a 5*5 matrix and multiplying it with each and every pixel in an image

```
Matrix=[0 0 0 0 0;
        0 1 1 1 0;
        0 1 1 1 0;
        0 1 1 1 0;
        0 0 0 0 0;]
```

By using the following command, convolution is done

```
Im=conv2(image,Matrix)
```

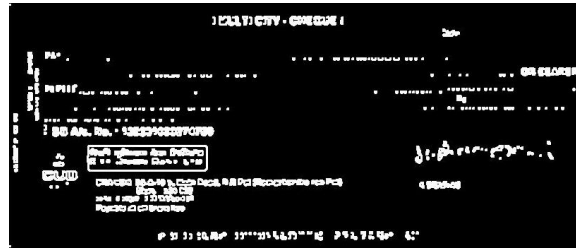


Fig.11. Convoluted Image

Localization of signature

Once we determine the possible area of signature by scanning the image vertically and horizontally. We expect the cheque to have a maximum number of dark spots. Thus, we were able to locate the signature from the cheque image.



Fig.12. Localized signature

Slant Correction (1)

Slant correction is done by first rotating the image by 30 degrees in the clockwise and accommodating the signature that have the heavy slant angle. Then the image is rotated in anti-clockwise in steps of 2 degree each time and horizontal position is calculated. The rotation is stopped when the horizontal position reaches the maximum and the slant angle is the difference of 30 degrees and the angle at which the horizontal projection is maximum.

Steps involved in slant correction

- Moving signature to the origin
- Rotating the signature and passing to the new coordinates

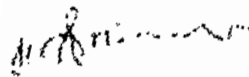


Fig.13. Slant corrected image

VI. IMPLEMENTATION

Image Comparison

The comparison of signatures is done with the help of edge detection technique. First apply the edge detection to the input image then apply edge detection to the images in the database which needs to be verified with the input image. Calculate white & black points in the input image. To find the matched data in the images, we are comparing the white edge points with the image in the database. we are finding the matched percentage of the images using the white points & total data.

Edge detection

To obtain the white and black points and the edges of the of the object in the image and then we go for a code in the matlab to extract white and black points in a image [2].

To extract white and black points in an image:

```
for a = 1:1:87
for b = 1:1:324
if(edge_det_pic1(a,b)==1)
white points = white points+1;
```

To compare the white edge points in the two images:

```
for i = 1:1:87
for j = 1:1:324
if(edge det pic1(i,j)==1)&&(edge det pic2(i,j)==1)
matched data = matched_data+1;
else
```

Percentage Matching

Percentage matching is performed to calculate the matched percentage between the two images.

$$\text{Total matched percentage} = (\text{matched data} / \text{total data}) * 100$$

$$\text{Total data} = \text{white points}$$

So that if the matched percentage is equal to zero then the images is not matched.

Valid cheque

If the matched percentage is greater than zero, it will check for the threshold for accuracy what we had given for the valid cheque, hence the signatures are valid.

CUB BANK preprocessing output



INDIANBANK preprocessing output

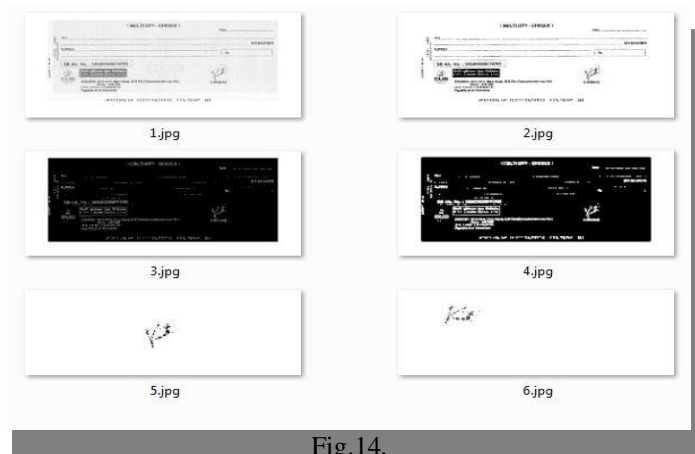


Fig. 14.

The analysis of signature verification is done by evaluating the FAR & FRR.

FAR – False Acceptance Ratio:

The false acceptance ratio is given by the number of fake signatures accepted by the system as the genuine signature.

FRR – False Rejection Ratio:

The false rejection ratio is the total number of genuine signatures rejected by the system as the genuine one.

ERR – Error rejection Rate:

The point at which the FAR and FRR meet with each other is known as ERR.

Analysis of the verification system

Bank Name	FRR (False rejection rate)	FAR (False acceptance rate)	APT (Average processing time)
CUB	0.1%	0	36
HDFC	0.2%	0	34
STATE BANK	0	0	26

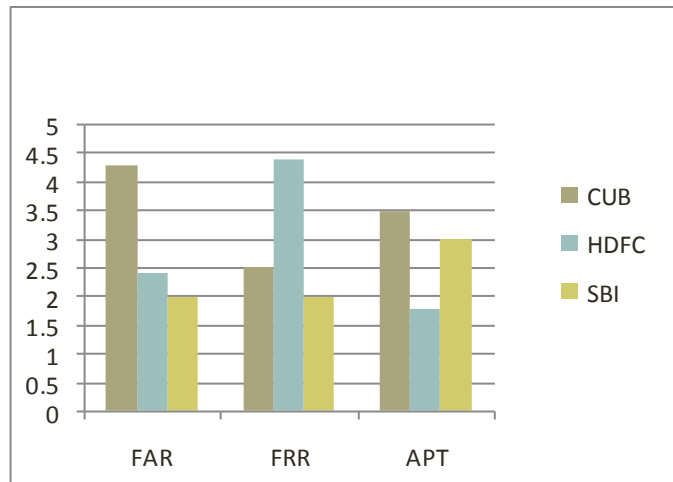


Fig.15. Graph of the verification system

VII. CONCLUSION

Image captured is converted into a gray scale image which resolute the authoritative regions in the cheque that includes the account bearer’s signature. The contour classification ensures the segmentation of the characters on the cheque. It is then localized, and compared with the account holder’s source of information and clarified and passed on. Any checks that are not successfully read and matched are highlighted as an exception and immediately forwarded to the client for further action.

The proposed algorithm can be used as a effective signature verification system in the banking industry. We presented a new off-line base cheque verification algorithm .The results show the FAR and FRR in the verification process and the success ratio of our results are high. Using our verification algorithm a great number of forgeries can be removed.

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