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Signature Verification Using DTI and Guided DTI Classifiers and Digital Encryption

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Abstract: Signature is a person's name depicted graphically or handwritten as a form of identification in order to authorize a check or it is a mark (sign) made by an individual to execute a document and signify knowledge, approval, acceptance. The main area of research on signature verification is in field of optical character recognition and digital image processing.Many methods are used for detection of forged signatures. We provide a different approach to determine whether a particular signature truly belongs to a person or not by using two classifiers i.e. DTI and Guided DTI.With addition of that digital encryption is also implemented to encrypt the signature to ensure the security purpose so that no one can copy the signature of another person.We provide Matlab as a simulation tool for implemented this method.

Keywords: Decision Tree Induction, Guided Decision Tree Induction, Convex Area, Digital Encryption

I. INTRODUCTION

A digital image is a representation of a two dimensional image as a finite set of digital values, called picture elements or pixels. Pixel values typically represent gray levels, colors, heights, opacities etc. Digitization implies that a digital image is an approximation of a real scene.The objective of the signature verification system is to discriminate between two classes of signatures: the genuine and the forgery,which is related to intra-class and inter-class variability[8]. The signature forgery can be classified into three categories such as Random forgery, Simple forgery and skilled forgery.

a.Random forgery: The signer uses his own style to forge the victim sign to create a forgery is called random forgery. Random forgery considers for the most of the forgery cases even though, it is very easy to recognize by the naked eye.

b.Simple forgery: The signer does not have any prior experience to forge thevictim sign for forgery is called simple forgery. Simple forgery is also very easy to detect by human eye.

c.Skilled forgery: Skilled forgery is the most difficult than rest of all forgeries. The signer is professional and has experience to copy the victim sign tomake forgery. It is very hard to recognize by eye even by the verification system[12].

Automatic signature verification methods can be of two types: on-line and offline. Online methods measure the sequential data such as coordinates of writing points, pen pressure, angle and direction of the pen. This data in the form of electronic signals is obtained from an acquisition device such as tablet throughout the signature apposition process[13].Offline methods use a camera or scanner that performs signature acquisition images from documents after the completion of signature apposition process.

The purpose of this work is todetermine whether a particular signature truly belongs to a person or not by using two classifiers i.e. DTI and Guided DTI.Decision Tree Induction i.e. DTI uses a tree like structure to have and process the information that is given as input to it. It uses the concept that for a particular thing to match the other thing it is not mandatory that all the features of one thing are dead similar to the other.It takes the minute changes and dissimilarities into its stride. DTI often does a wonderful processing and classification of different objects in image processing.But with sometime the changes are big and very important in DTI these changes are overlooked due to which the performance of the system is degraded. In Guided DTI we are trying to enhance the performance of the DTI by deciding previously which features are absolutely mandatory and which features not absolutely mandatory.By doing that we are actually reducing or rather eliminating the chances of faulty classification because when the main and the most important features are matched or mismatched the chances of wrong classification are almost zero.

The main aim of digital encryption is that it encrypts signature digitally by making use of private and public keys because if any person have seen the signature of another person then he can easily copy that signatures and can misuse that signatures for unauthorized actions.So with the use of encryption we can hide the person's signature digitally and make it secure.

In this research we have taking at least five samples of different persons and scanned.These scanned signature images are then subjected to image enhancement operations for preprocessing i.e opening and closing operations.From these pre-processed signatures, features such as convex area,normalised area,aspect ratio are extracted and stored. These values are used by decision tree induction and guided decision tree induction to classifies the signature into original or forged based on a above extracted features.Next step is to compare both these classifiers to determine which gives better result.Atlast we add a digital encryption to make signatures secure and can be digitally compared.

II. LITERATURE SURVEY

Shi C. et. al (2007) proposed a scene text recognition method which is connected with structure guided character detection and linguistic knowledge. In this we use treestructures which is used to detect and recognize characters at the same time. In this the character models uses both the local appearance models and global structure models .By making the use of detection scores and language models we can find the sequence of characters from decision view. The main aim of this paper is to detect the scene characters and text. At last character sequence is find by using Viterbi algorithm [4].

Sharma D. Veer et. al (2009) proposed a method for machine written gurmukhi and handwritten text by analyze the various errors in the text and further correct it for use. This method depends upon the similar shape between the characters. It classifieds the consonants into different parts and a unique no is given to it. If any error occurred in the consonants shape then it is corrected by this method. In this paper encoding is done on words which depends on consonants and then find in the dictionary. If the word is not find in the dictionary it means that match with the original word. If the word is matched with original word then result is perfect otherwise we search in the dictionary for words with same codes depends on the similar original words. This paper used the output of optical character recognition of both the documents. The main aim of this method is to find the similar shape of the handwritten document and machine document. This method eliminates the duplicity problem in documents and also reduces the errors in the documents. The method proposed a effective approach for gumukhiocrscript[5].

Shekhar B.H. and Bharathi R.K.(2011) proposed a method to verify the signatures depends on the two further parts. First the signature is preprocessed to make the signature better in which we take scan signature and changed in to a new shape. Next the new shape of signature extracts the features by using eigen-signature. The Kannada signature database is created to implement this method for better performance. At last the technique of this paper has been compared with the proposed techniques that performs offline signature verification[3].

Haquel M. Asraful and Ali T. (2012) proposedan novel method for signature verification of signatures by making a partition of images in to further blocks. The method method based on the structure of images. It extracts the various features in the signatures by dividing the signature into parts. The main features which play the key role in this technique are image center and block centers, Euclidean distance between image center to each block center and number of pixels in each block. Every part or block of image has assign a weight based on the structure of images. This method reduces the two factors that is acceptance and rejection rate which is calculated in verification. At last we can say that this paper deals with all type of forgeries rather than the existing methods[16].

Alam M. Khorshed et.al (2013) proposed a method for two types of signatures that is offline as well as online to improve the security level of signatures. The signature is signed at the paper is changed into digital type in offline mode and computer is necessary for verification of signatures. This method detects the authenticity of real person by using offline and online signatures. Neural networks is the main key of this method which artificially performs the verification of signatures and make a comparison with the existing verification methods bye considering the main properties of signatures[17].

Kruthi .C and Deepika .C .Shet (2014) proposed a method which uses a support vector machine classifier to detect the originality of signatures depends on the features of created database. First part is to collect the samples of signatures from different persons and further preprocessed that signature to convert it into a gray scale image. The classifier takes gray scale image as input and make a decision plane between objects to make the classification. The signature image undergoes by different operations like filtering, detection of edges and thinning. The preprocessed signatures are further extract features like convex area, aspect ratio and number of loops and saved in database. The values are given to the classifier to make a hyper plane and detects the originality of signatures [12].

Shukla A. Kishore (2014) and Mohan P.(2014) proposed a novel approach to verify the handwritten text. We have taken the samples of signatures and preprocessed it by collect it. Collection of original signatures signed on a paper and features are extracted from these signatures. Then a comparison is done to match the signature of persons one by one to another person to check the same match of signatures. Verification is done by using different features to reduce the error rate .Permissible boundary, Hand pressure, Euclidian distance, Center of cylinder generated from minimum spanning tree, Delaunay triangulation of the signature, Angle between base line and center of gravity[1].

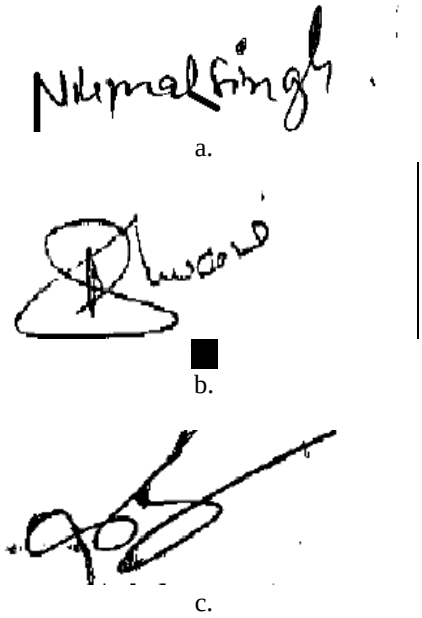
III. REALTED WORK

A reliable signature verification system is an important part of law enforcement, security control and many business processes. It can be used in many applications like cheques, certificates, contracts etc. The verification of signatures by taking the credentials of size and angle invariant for cheque system, there is probability of mismatch the characters in the signature of the user.

A. Decision Tree Induction:

In previous time many different methods are used for the verification of original signatures but the problem occurs is faulty classification and insecure i.e. in previous signature verification system if the dissimilarities in signatures is small then they are accepted but if the changes are big then these are overlooked due to which the performance of system is degraded.To address these challenges from previous issues, this work presents a framework i.e. Decision Tree Induction to reduce the chances of faulty classification by considering the main changes.Initially we have taking atleast five samples of different persons and scanned.These scanned signature images are then subjected to image enhancement operations for preprocessing i.e. opening and closing operations.Opening has the effect of eliminating small and thin

objects, breaking the objects at thin points and smoothing the boundaries/contours of the objects.Closing has the effect of filling small and thin holes, connecting nearby objects and smoothing the boundaries/contours of the objects[14].From these pre-processed signatures, features such as centroid, centre of gravity, calculation of number of loops, horizontal and vertical profile and normalized area are extracted and stored. These values are used by decision tree induction and guided decision tree induction to classifies the signature into original or forged based on a above extracted features.Next step is to compare both these classifiers to determine which gives better result.



a.

b.

c.

Fig.1 Sample Images

B. Feature Extraction:

Features describe the signature image uniquely. Features can be of two kinds global and local. Global features describe the signature image as a whole while in the local feature extraction the signature image is divided into a number of units and in each unit the global features are extracted[8]. Similar characteristics of a signature are called features of that signature and accurately extract those features called extraction. This process identifies and differentiates a person's signature from another. This process can be done based on different type features such as global features, local features, geometric features, texture features mask features and grid features.

The objective of the work is to reduce the two vital parameters False Acceptance Rate (FAR) and False Rejection Rate (FRR) normally used in any signature verification scheme. In the end comparative analysis has been made with standard existing schemes. We select the image whose features we want to know the features are displayed in the blue panel.

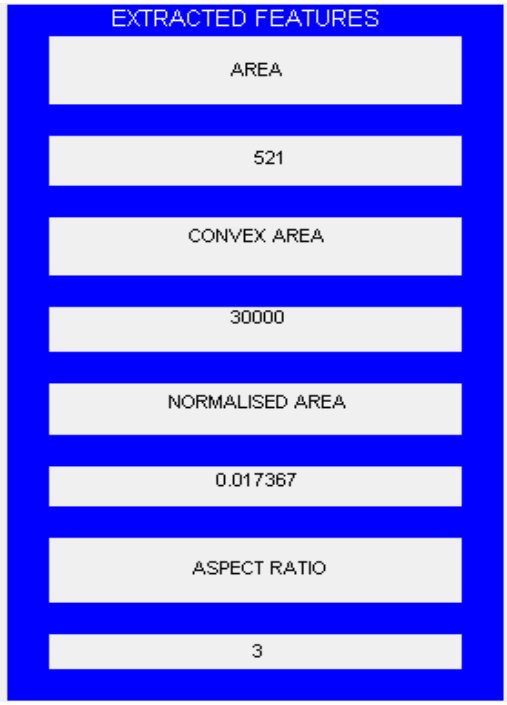


Fig. 2 Features

C.Previous Work: *T*he previous method provide a offline signature verification system that uses support vector machine tool to classify the signatures.A support vector machine (SVM) is a tool used for classification and regression prediction and is based on machine learning theory in order to maximize predictive accuracy[4].The main aim of SVM is to draw a decision plane among a set of objects having different class memberships and classify them.

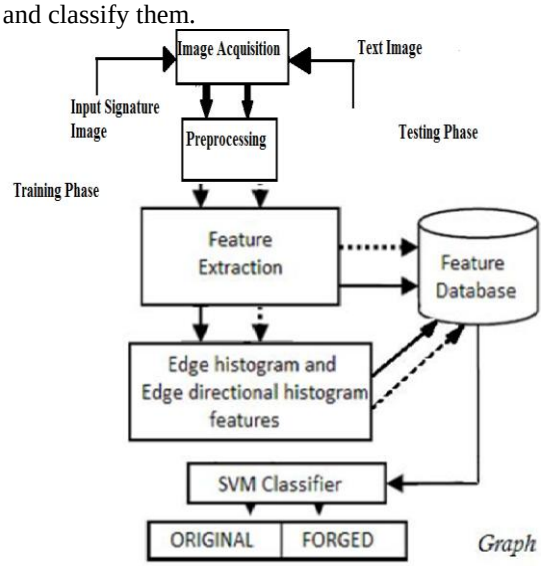


Fig. 3 Previous Work

IV. Proposed Work: In this workwe have taking atleast five samples of different persons and scanned.These scanned signature images are then subjected to image enhancement operations for preprocessing i.e. opening and closing operations.Opening has the effect of eliminating small and thin objects, breaking the objects at thin points and smoothing the boundaries/contours of the objects.Closing has the effect of filling small and thin holes, connecting nearby objects and smoothing the boundaries/contours of the objects[14].From these pre-processed signatures, features such as centroid, centre of gravity, calculation of number of loops, horizontal and vertical profile and normalized area are extracted and stored. These values are used by decision tree induction and guided decision tree induction to classifies the signature into original or forged based on a above extracted features.Next step is to compare both these classifiers to determinewhich gives better result.Atlast we add adigital encryption to make signatures secure and can be digitally compared.

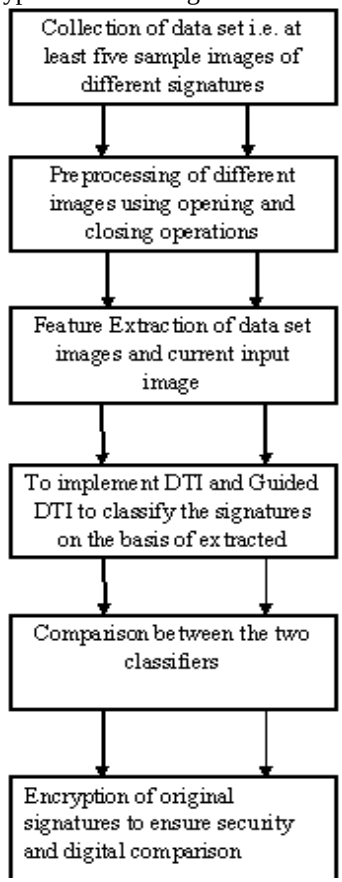


Fig. 4Proposed Work

A. Data Set: Data set consists of five sample images of checks. These images are of different persons and are of different pixel qualities.

B.Preprocessing of the images: The image which is selected is first opened then the signature portion is focused and improved suitably by using morphological operations i.e. Open and Close so that the image of signature can be obtained clearly and recorded.

1.Morphological Operations: We have used two morphological operations i.e. Open and Close which are described below:

a.Open Operation: It tends to remove some of the foreground (bright) pixels from the edges of regions of foreground pixels.The effect of the operator is to preserve foreground regions that have a similar shape to this structuring element, or that can completely contain the structuring element, while eliminating all other regions of foreground pixels.

b.Close Operation: It tends to enlarge the boundaries of foreground (bright) regions in an image (and shrink background color holes in such regions).The effect of the operator is to preserve background regions that have a similar shape to this structuring element, or that can completely contain the structuring element, while eliminating all other regions of background pixels.

C. Feature Extraction: The processed image is then stored and the features are extracted for the signature such as area of the signature, convex area of the signature, normalized area of the signature and aspect ratio of the signature. These all features are:

a. Area of the Signature: It is defined as the area covered by the black pixels in the preprocessed image.

b. Convex area of the Signature: Area covered by total number of pixels in the image i.e. resolution of the image. If the image is X * Y size then then their product is the convex area.

CA =X x Y Sq.unit[18]

c. Normalized area of the Signature: It is the ratio of the areas covered by the signature pixels to the area covered by the whole signature box.

NA =Area of signature/Area of bounding Box[19]

d. Aspect ratio: Itis the ratio of height of the image to the width of the image.

AR=W/H

V. IMPLEMENTATION OF DTI AND GUIDED DTI

Both the processes to verify the signatures are implemented such that we can compare the present signature with the previous original signature available in the database.The working of both the classifiers are explained below:

a. Decision Tree Induction: It used a tree like structure to have and process the information that is given as input to it. It uses the concept that for a particular thing to match the other thing it is not mandatory that all the features of one thing are dead similar to the other. It takes the minute changes and dissimilarities into its stride. DTI often does a wonderful processing and classification of different objects in image processing. But with sometime the changes are big and very important in DTI these changes are overlooked due to which the performance of the system is degraded.In this classifier we use amultistage or sequential hierarchical decision scheme. The basic idea involved in any multistage access is to break up a difficult decision into a set of several simple decisions, hoping the final solution achieved in this way would simulate the expected desired solution.

b. Guided Decision Tree Induction: In Guided DTI we are trying to enhance the performance of the DTI by deciding previously which features are absolutely mandatory and which features not absolutely mandatory. By doing that we are actually reducing or rather eliminating the chances of faulty classification because when the main and the most important features are matched or mismatched the chances of wrong classification are almost zero. To understand better let us take an example. Let A, B, C, D and E are five features of an object. And one out of features A and B is absolutely mandatory. Now as the presence of A or B con not be compromised the remaining three features C, D and E are to be managed such that the classification stands. Now if A is present B is not then C and D are mandatory, if B is present A is not then D and E is necessary, if A and B are both present any one of the other features will do and lastly if both A and B are not present then it is an absolute mismatch.

PREVIOUS DTI

ABCD Present

Or ABCE Present

Or ABED Present

Or AECD Present

GUIDED DTI

ACD Present

Or BDE Present

Or ABC/D/E Present

Fig. 5 DTI and Guided DTI

VI. COMPARISON BETWEEN BOTH CLASSIFIERS:

On the basis of comparing the forged and original signatures the both classifiers are compared as both independently used to check the signatures and provide the results.They are compared by using SNR and MSE parameters.

1. SNR and MSE: SNR stands for signal to noise ratio and is used in imaging as the physical measure of the sensitivity and is calculated in decibels (dB) and is defined as the ratio of average signal value to the standard deviation of the background.

If average signal value is denoted by μ_{sig} and standard deviation by σ_{bg}, then

$$\text{SNR} = \frac{\mu_{\text{sig}}}{\sigma_{\text{bg}}}$$

MSE stands for mean square error, is used to find the difference in the estimator and estimate by calculating the average of square of the errors.

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(\hat{Y}_i - Y_i)^2.$$

Above is the equation to calculate MSE of an image.If $\hat{Y}$ is a vector of n predictions, and Y is the vector of the true values.

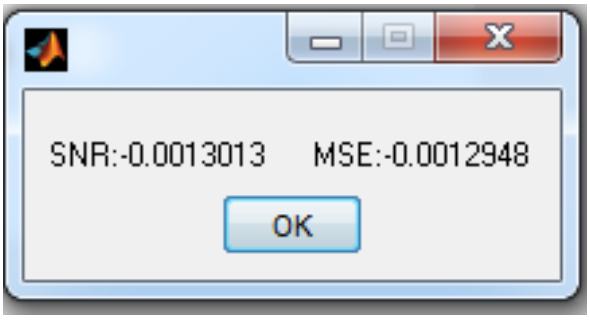
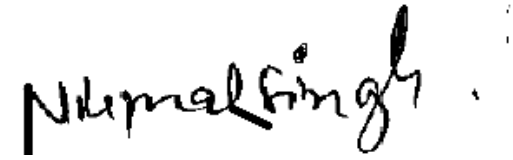


Fig. 6SNR and MSE Result

VII. RESULTS AND SIMULATION

In this work we have used two classifiers to verify the signatures of a person on check with the signatures which are original. For this purpose we selected the person name whose signature we want to verify. First we filter the image using median filter and then the signatures are tested using following classifiers:

- DTI (Decision Tree Induction)
- Guided DTI



a.

b.

Fig. 7 (a) and (b) input image 1 and 2

Fig.8 Result of DTI

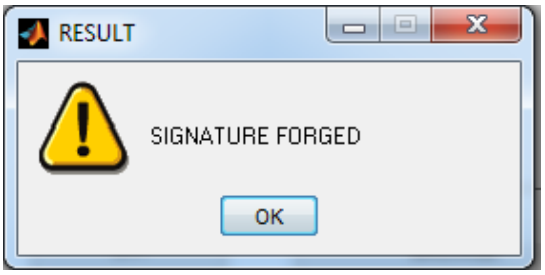


Fig. 9 Result of Guided DTI

In above figure 7(a) and 7(b) are the input images on which signature verification is implemented. Result is shown in figure 8 and 9 using DTI and Guided DTI. Guided DTI is more efficient as compared to DTI as in Guided DTI the chances of selection reduces or removed as the faulty or unnecessary selection measures are left behind. In Guided DTI the selection measures are only the required one not like DTI in which the selection is done on the basis of present features.In DTI the selection is done on the basis that minimum four features are available but in Guided DTI selection is done on the basis of features required.

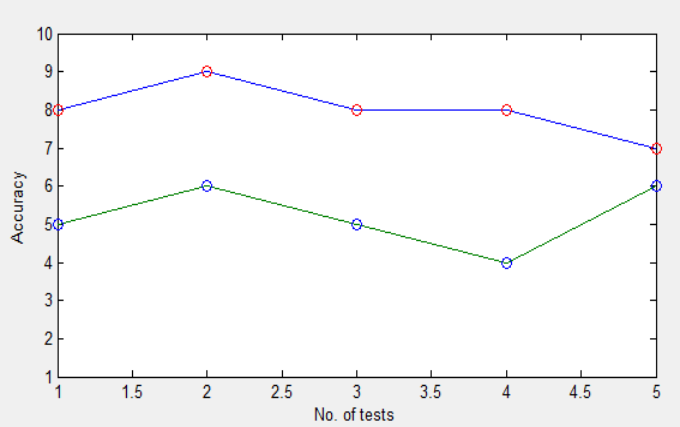


Fig.10 Accuracy Graph

In the above plot the green line shows the accuracy of DTI and the blue line shows the Guided DTI accuracy.

VIII. DIGITAL ENCRYPTION

The original signatures are encrypted such that the original signatures are safely managed in database and can be utilized whenever required. The main aim of digital encryption is that it encrypts signature digitally by making use of private and public keys because if any person have seen the signature of another person then he can easily copy that signatures and can misuse that signatures for unauthorized actions.So with the use of encryption we can hide the person's signature digitally and make it secure.

IX. CONCLUSION

In this study we have elaborated the two classifiers to verify the signatures on the checks as it is very significant requirement to find the forged signatures. So the verification of signatures is done by classifiers

- DTI
- GUIDED DTI

These classifiers are very efficient but Guided DTI is more reliable as compared to previous DTI as it is more precise in detecting the forged signature.Preprocessing the image on the basis of morphological operations are completely done in this project, along with the calculating the features of the image i.e. Area, Convex area, Normalized area and Aspect Ratio. Encryption of the original image is also successfully done.

X. FUTURE SCOPE

In this research we presented two classifiers for signature verification. These classifiers are very precise and with the help of guided DTI we can get more precise result. We presented the comparison among both the classifiers. In future the verification can be enhanced by bringing advancement in the classifiers.
Future scope of this project is also that, as the signature is more precisely checked and verified so we can use them for security purposes like:

- System Lock
- Door open close
- File security
- All such security measures can be taken with signature also.

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