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OFFLINE SIGNATURE VERIFICATION METHOD OF PARALLEL PROCESSING USING ANGLE FEATURE, PIXEL DENSITY FEATURE , CHAIN CODE AND MIXED FEATURE

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ABSTRACT

Signature recognition by computer processing has been approached as soon as the computer technology gave sufficient power for the implementation of image processing techniques. The research work developed can be divided in two categories: on-line and off-line recognition. The performance of signature verification system used neural network. The proposed method was successfully made the offline signature verification with improve the efficiency and accuracy and easily can detected the skilled forgeries. Neural network is used as a classifier for this system. In the results are compared with both the very basic angle, chaincode, energy density method and a mixed feature method of offline signature verification system.

KEYWORDS:- Neural network, Parallel processing, feature extraction, chain code, etc.

INTRODUCTION

Human signature are used every day for the identification of a person in various work like for processing Bank checks, but along with the signature it is also required to verify that the signature on the paper is signed by the genuine signer or a forgery signature. Also the signature signed by a genuine signer may be different depends upon various conditions like his mood, health etc, and also there is a variation in the signature according to age. So it is required to keenly observe the signature before reaching to any conclusion. This give rise to make a computerized signature verification system .and also it become the subject of continue research until a purely faithful system is found to rely on. In this paper is like one of a small step forward towards achieving the goal of a developed system for signature verification. Before modeling the system it is required to know about the signature characteristics [1], Types of forgeries [2] and also the signature verification systems.

SIGNATURE CHARACTERISTICS

The signatures of a person may be different in shapes and size and it is difficult for a human being to separate a genuine signature from the forged one by only visual analysis of the signatures. Signatures may be simple like a signer writes his name in a simple way, cursive when written in cursive way or graphical that contents some geometric patterns. So for making the automatic offline signature verification system, signature must be treating as an image and extracting features from the image. But before modeling such system some essential characteristics are keep in mind like:

- Invariant
- Uniqueness
- Inimitable
- Reducible and comparable

Types of Forgeries:

There are three kinds of forgeries -Random, Unskilled and Skilled (Fig. 1).

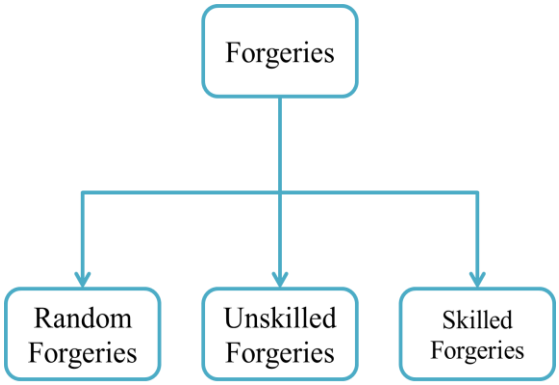

Fig: 1 Forgery system

Random forgery. It is produced when the signer knowing the name of the victim and produced signature in his own style.
Unskilled forgery. It is produced when the signer copy the signature in his own style without having any previous experience.
Skilled forgery. It is produced by looking the original signature or by having idea about the signature of the victim. The generally this kind of forgery is generated by the professional persons who have experience in copying the signature.

Signature Verification Systems
Automated handwritten signature verification can be divided into two classes, namely, on- and off-line. On-line data records the motion of the stylus while the signature is produced, , possibly velocity includes location, pen pressure and acceleration, as functions of time system. Online systems use this information captured during possession. These dynamic characteristics are specific to each individual and sufficiently stable as well as repetitive. In the off-line signature verification systems, the signature is captured once the writing process is over and thus only a static image is available. As compared to on-line signature verification, and off-line systems are difficult to design as many desirable characteristics such as the order of stroke, the velocity and other dynamic information are not available in the off-line process. The verification process has to wholly rely on the features that can be extracted from the trace of the static signature image. Although difficult to design, an off-line Signature verification is crucial for determining the writer identification as most of the financial transactions in present times are still carried out on document. Therefore, it becomes all the more essential to verify a signature for its authenticity.

RELATED WORK

Md. Asraful Haque, the study in this paper, prposed the Improved Offline Signature Verification Method Using Parallel Block Analysis. A signature image is divided into some blocks. In individual threads will work on each block. In approach is based on feature extraction of every block derived from the image. Each type feature has a different impact for assigning some weightage to a block. The scheme will be very useful for signature identification where the database is very large. In value of FAR and FRR should be very less for any good signature verification. Both FAR and FRR depend on the threshold variance parameter taken to decide the genuineness of an image. in high FRR of the experimental observation indicates that the system is strict and may reject original signatures.

Rahul Verma, done study in this paper, the **s**ignature used as a biometric is implemented in various systems as well as every signature signed by each person is distinct at the same timeing. It is very important to have a computerized signature verification process. In offline signature verification system dynamic features are not available obviously, but one can use a signature as an image and apply image processing techniques to make an effective offline signature verification process. Author proposes a intelligent network used directional feature and energy density both as inputs to the same network and classifies the signature. The neural network is used as a classifier for this system. Tthere areare compared with both the very basic energy density method and a simple directional feature method of offline signature verification system and this proposed new network is found very effective as compared to the above two methods, in specially for less number of training samples, in which can be implemented practically. In this paper, it is also observed that accuracy of energy density method is increasing rapidly as training sample increases but other two methods shows almost considerable results for all the training sample sets. Author has also observed that the results for FRR are varying randomly for all the cases [1].

CHAIN CODE (CC)

Shape approximation technique in feature extraction stage, particularly chain code has been widely used to encode the boundary line because of its simplicity and low storage requirement [5]. Chain Code representation gives the boundary of signature image where the codes represent the direction of where is the location of the next pixel from current point.

Chain codes are used to represent a boundary by a connected sequence of straight-line segments of specified length and direction. Direction of each segment is coded by using a numbering scheme such as the ones shown in Figure 2.

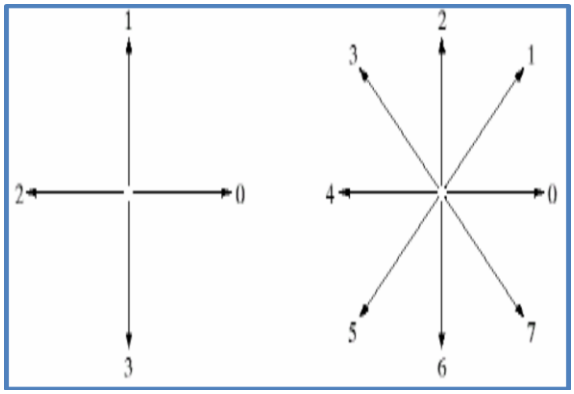

Fig: 2 Direction and 8-direction chain code

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The method generally is unacceptable for two principal reasons:

- The resulting chain of codes tends to be quite ling and,
- In any small disturbances along the boundary due to noise or imperfect segmentation cause changes in the code that may not be related to the shape of the boundary.

An approach frequently used to circumvent the problem just discussed is to resample the boundary by selecting a larger grid spacing, because illustrated in Figure 3.

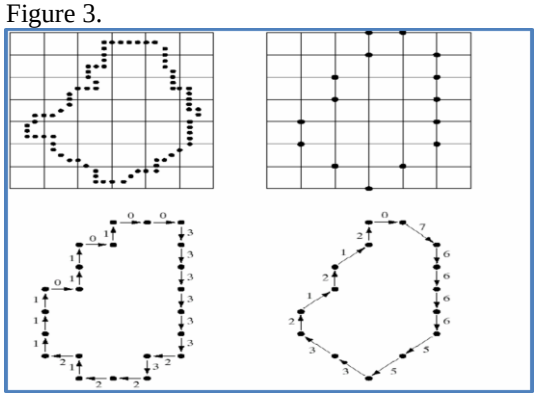

Fig: 3 Concept Object boundary

ENERGY DENSITY

In this method, two features are used for training. Aspect ratio is used as a global feature and energy density is used as local feature. Aspect ratio is the ratio of Height (maximum vertical distance) to length (maximum horizontal distance) of the signature. The have calculated it after skew removal. In energy density is defined as the total energy present in each segment. Done 100 segments of each signature and energy density is obtained by counting the total number of 1s in each segment (i.e. Total White Pixels). Thus, we have a feature vector of size 101X1 for energy density method as final record. This final database is fed to the neural network to perform the desired function i.e. training or classification.

Fig: 4 Image partitioned into four parts

Angle Feature

In this method first the Pre-processing image is resized and partitioned into four portion or cell using the equal horizontal method after that each partition(cell) are divided in to 3 row and 3 column of equal size so we have total nine sub cell of each cell. Following that consider the sub cell one by one and calculate the angle of each with pixels by considering the bottom left corner after that calculate the mean value of the angles this process is repeat for all the sub cells. Once the value of angles for each sub cell is found then calculating the mean value from that to determine the value of angle for that cell or dividing wall. This process is repeat for the reaming three partitions, at the end we have the angle vector of size 1*4. This is given as an input to the neural network system. For example the data base used consist 100 signature data. For one sample we have angle vector of size 1*4 so for all 100 sample we have feature vector of size 100 *4 which is used as a final data base for training the neural network and also for classification.

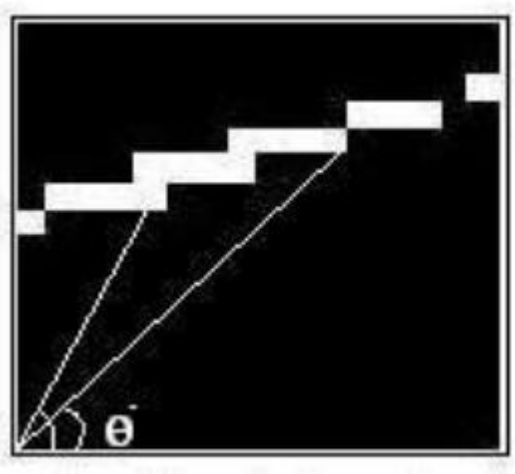

Fig: 5 Find the angle and calculate the mean value

NEURAL NETWORK

The main reasons for the widespread usage of neural networks (NNs) in pattern recognition are their power (the sophisticated techniques used in NNs allow a capability of modeling quite complex functions) and ease of use (as NNs learn by example it is only necessary for a user to gather a highly representative data set and then invoke training algorithms to learn the underlying structure of the data). The signature verification process parallels this learning mechanism. There are many ways to structure the NN training system, but a very simple approach is to firstly extract a feature set representing the signature, with several samples from different signers. Second step is for the NN to learn the relationship between a

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signature and its class (either "genuine" or "forgery"). Once this relationship has been learned, the network can be presented with test signatures that can be classified as belonging to a particular signer. The NNs therefore are highly suited to modeling global aspects of handwritten signatures.

METHODOLOGY

Signature is a special arrangement of symbols, characters, etc., and may be simple, cursive or geometric. Generally the static feature *i.e.*, the image of the signature is available for the verification and authentication of a genuine person because it is not possible everywhere to capture the dynamic feature. So here we propose a system that works on the static features. The static features that consider of the signature for modeling an offline verification system are an Angular feature in the combination of the Energy density feature which extract locally and the feed forward back propagation neural network use as a classifier. Aspect ratio is also included as a global feature in energy density method. The proposed system includes both signature verification and forgery detection parts. The difference between the two parts is that verification is based on inherent characteristics of a signer whereas the detection is based on specification of a limit, which exceeds the inherent variation in the genuine Signatures of a signer.

In this section, block diagram of system is discussed. Fig. 6 gives the block diagram of proposed signature verification system which verifies the authenticity of given signature of a person.

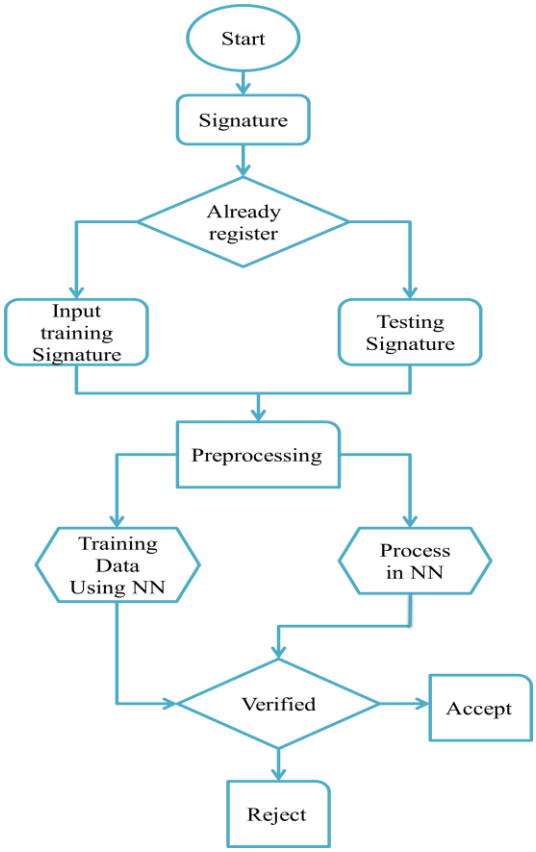

Fig: 6 Signature Recognition & Verification

- Input image source (offline process)
- Acquire the Signature images.
- Signature testing, not found the signature on the list than reject
- Preprocessing on signature image
- Apply Neural Network Processing/ Training data processing with NN
- Verified signature process

RESULTS AND DISCUSSION

Three performance parameters have been used in this project to evaluate the classifier namely FAR, FRR and recognition rate. The different feature , angle, energy feature, chain code and mixed feature are used in this project with single core and multicore operation. The time required for feature extraction is given below.

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TABLE: 1 Comparative performance on the basis of Accuracy in %

S.no.	No of Training samples	Result			Proposed Method				
		Accuracy (Pixel Density Method)	Accuracy (Angle)	Accuracy (Pixel density + Angle)	Accuracy (Pixel Density Method)	Accuracy (Angle)	Accuracy (Pixel density + Angle)	Accuracy (Chain Code)	Accuracy (Chain Code + pixle density)
1	10	61	67	72	80	70	88	93	82
2	20	64	70	75	63	80	96	98	96
3	30	70	78	87	92	95	98	93	95
4	40	74	79	90	90	98	99	96	98
5	50	80	85	95	98	100	100	98	100

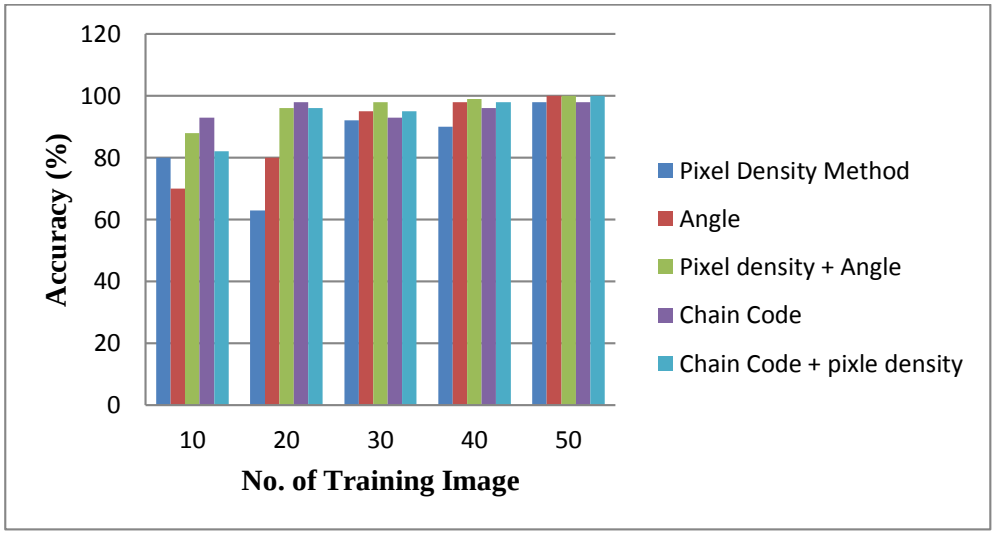

Fig: 7 Accuracy Vs No. of Training Image

TABLE: 2 Comparative performance on the basis of FAR in %

S.No	No of Training samples	Result			Proposed Method				
		FAR (Pixel Density Method)	FAR (Angle)	FAR (Pixel density + Angle)	FAR (Pixel Density Method)	FAR (Angle)	FAR (Pixel density + Angle)	FAR (Chain Code)	FAR (Chain Code + Pixel density)
1	10	43	46	14	00	24	00	00	02
2	20	46	48	04	04	04	00	00	00
3	30	33	30	00	10	00	00	04	00
4	40	32	28	00	12	00	00	02	00
5	50	26	25	00	00	00	00	02	00

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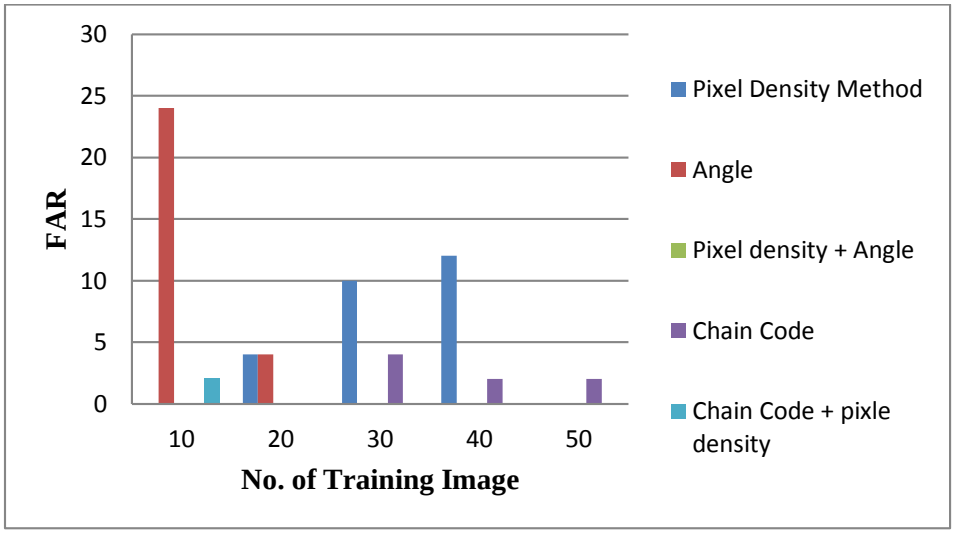

Fig: 8 FAR Vs No. of Training Image

TABLE: 3 Comparative performance on the basis of FRR in %

S.no.	No of Training samples	Result			Proposed Method				
		FRR (Pixel Density Method)	FRR (Angle)	FRR (Pixel density + Angle)	FRR (Pixel Density Method)	FRR (Angle)	FRR (Pixel density + Angle)	FRR (Chain Code)	FRR (Pixel density + Chain Code)
1	10	12	17	20	40	36	22	12	33
2	20	20	22	10	70	34	05	02	04
3	30	10	08	08	02	06	02	08	04
4	40	22	16	08	08	02	02	02	02
5	50	18	05	00	04	00	00	02	04

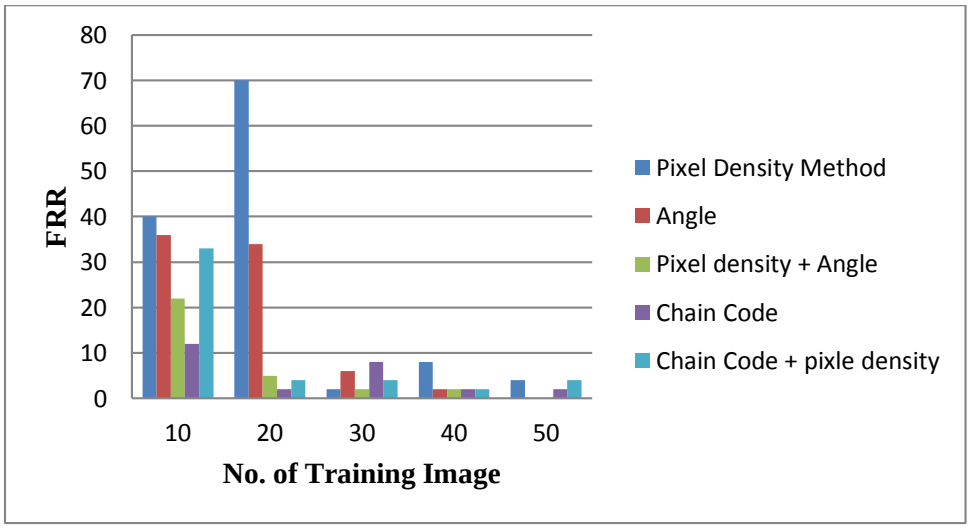

Fig: 9 FRR Vs No. of Training Image

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TABLE: 4 Compression Table of Review work for FAR and FRR

Input Type	Feature extraction based on no of pixels & distance measurement from Image-center to Block-center		Proposed method									
			ENERGY		ANGLE		CHAIN CODE		ENERGY+ANGLE		ENERGY+CHAIN CODE	
	FAR	FRR	FAR	FRR	FAR	FRR	FAR	FRR	FAR	FRR	FAR	FRR
Skilled forgery	2.8 %	_	2%	_	0	_	2 %	_	0	_	0	_
Original Signature	_	16.53 %	_	4 %	_	0	0	2%	_	0	_	0

TABLE: 5 Compression Table of Review Work

Input Type	No of Signs	Feature extraction based on no of pixels & distance measurement from Image-center to Block-center		Proposed method									
				ENERGY		ANGLE		CHAIN CODE		ENERGY+ANGLE		ENERGY+CHAIN CODE	
		Accepted	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted	Rejected
Skilled Forgery	250	7	243	6	244	0	250	2	248	0	250	0	250
Original Signature	375	313	62	340	35	361	14	373	2	375	0	375	0

CONCLUSION

The performance of signature verification system used neural network. The proposed method was successfully made the offline signature verification with improve the efficiency and accuracy and easily can detected the skilled forgeries. The proposed directional feature with energy method on the basis time required for training, accuracy, False Acceptance Ratio & False Rejection Ratio. After many experiments and observations author comes to the conclusion that if the samples available for training are limited then mixed feature method is better then angle and pixel density method. Due to handwritten images there are mismatch in the images and it is rejected by the classifier hence having higher FRR but low FAR.

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