

Altered Fingerprint Detection Techniques: A Review

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Abstract: Now a days fingerprint recognition systems is facing a lot of problems. Detecting altered fingerprints is one of them. Fingerprint alteration is nothing but changing the ridge structure of fingerprint for masking one's identity and evading fingerprint recognition system. Existing systems of fingerprint system have limited capability in recognizing altered fingerings. This paper gives the review of techniques used to detect altered fingerprints.

Keywords: Altered Fingerprint, NFIQ, SVM, Artificial Neural Network.

1. INTRODUCTION

Fingerprint alteration is the critical problem to border control and other security systems. Criminals are breaking the security chain by using altered fingerprints day by day. Fingerprint alteration is the process of changing the ridge structure of the fingerprints so that it can mask their identity. Fingerprint have various features such as singular points, minutiae, loops, whorls, Arch, etc. These features are used to match altered fingerprints. When the fingerprint is altered then these features changes abruptly. By observing the change in these features the altered fingerprint is analyzed.

Depending on the change observed in the ridge structure, the altered fingerprints are classified as distortion, obliteration and imitation. When the fingerprints are altered by cutting, abrading, applying strong chemicals on fingertips then that alteration comes under the obliteration. The friction ridge patterns can be turned into unusual patterns by performing surgery or by stitching the fingerprints, etc. then this is called distortion.

The fingerprints are made imitated by performing complex plastic surgery or skin transplantation. The imitated fingerprints looks same like normal fingerprints. The automatic fingerprint detection system cannot detect these fingerprints. Following figure shows altered fingerprints.

Altered fingerprints structure differs from natural fingerprints in many aspects. The changes are observed in the minutiae, orientation field, singular points, ridge texture and ridge period, etc. Minutiae in the normal fingerprint and altered fingerprints are not same, altered fingerprints have more than

one singular point where as normal fingerprints have one singular point with highest amplitude, normal fingerprints have smooth orientation field where as altered fingerprint does not have, ridge period in normal fingerprint is nearly same but in altered fingerprint it is not same.



Fig 1. Altered Fingerprints

2. TECHNIQUES FOR DETECTION OF ALTERED FINGERPRINTS

Altered fingerprint detection is one of the challenging problem in the current fingerprint recognition systems. There are following techniques available for detection of altered fingerprints.

1. NFIQ

National institute of standards and technology's Fingerprint Image Quality (NFIQ) software is used to detect altered fingerprint. It is an open source tool used for measuring the quality of fingerprints. It is independent of the software which is used for verification. NFIQ uses five different classes for measuring the quality of fingerprint image. Class one represents best quality whereas class five shows poor quality. It uses eleven different features of input image to measure the quality of image based on Artificial Neural Network. NFIQ can work only with the Gray scale image or intensity image.

The NFIQ detects the altered fingerprints only if the image quality of altered fingerprint is not good. It can detects only 20 % altered fingerprints [2]. The existing NFIQ algorithms

is optimized and the detection rate of the altered fingerprints is also increased with the optimized NFIQ algorithm [7].

2. SVM

Support Vector Machine (SVM) is kernel based method. It is group of supervised learning algorithms which are used for classification or in the detection. It is used when our data is having exact two classes for giving output or result. It uses support vectors for decision making. Support vectors are the data points which are close to the particular class. These are used in the pattern recognition areas.

Support Vector Machine (SVM) having good accuracy in the typical type of altered fingerprint. The features such as singular Points in the orientation field, minutiae density map, ridge discontinuity etc. are extracted and fed to support vector machine to classify the input fingerprint into altered or natural fingerprints. Training and classification in the support vector machine is very efficient. [1] [2] [10] [13] [15]. If the dataset is large then it is very complex procedure to train the support vector machine. It can detect 92 % of altered fingerprints mainly distorted and obliterated fingerprints are detected correctly

The available fingerprint quality control software works only if the fingerprint image quality is better. These quality control software cannot always detect altered fingerprints because alteration doesn't change the quality of fingerprint image. The problem of altered fingerprint is considered here. Altered fingerprints are detected based on the analyzing ridge orientation of altered fingerprints. The orientation field of natural fingerprints is different for different persons because number of singular points and location of singular points varies person to person. The proposed method decomposes the orientation field into two components i.e. singular orientation field and continuous orientation field. High level features are extracted from continuous orientation field.

Support Vector Machine (SVM) is used to classify the fingerprint as natural or altered. Its detection rate is 92% [1] there are various issues arising in case of fingerprint detection system. Detection of altered fingerprints is one of them. In this paper [2], an algorithm is proposed which is based on analyzing the orientation field and minutiae distribution in fingerprints. A high quality High quality fingerprint have smooth orientation field except at core and delta points. Ridge flow is not continuous in the altered fingerprints. Features are extracted from the orientation field. Minutiae are extracted from the open source minutiae

extractor tool. Minutiae in the natural fingerprints and altered fingerprints are not same. Minutiae density map is constructed. The features vectors of both orientation field and minutiae density map are fed to support vector machine (SVM) for classification of altered and natural fingerprints. Using the proposed algorithm 66.4 % altered fingerprints are correctly classified

J. Feng, A.K. Jain, A. Ross have proposed a technique to detect altered fingerprints mainly distorted fingerprints. Due to absence of database containing altered fingerprints they have synthetically generated altered fingerprint. NIST SD4 database is used for generating altered fingerprints. The orientation field of ridge structure varies from person to person or finger to finger. The proposed method detects altered fingerprints by analysing ridge orientation field. The ridge orientation field is distinguished into singular orientation field and continuous orientation field. High level features are extracted from continuous orientation field. Singular points are located by using Poincare index method. A feature vector named curvature histogram is extracted from continuous orientation field and this 42 dimensional curvature histogram is given as input to support vector machine for distinguishing between altered fingerprints and altered fingerprints. 92% of the altered fingerprints are detected [10].

A new method named SVM Kernel is proposed by R. Josphineleela for detecting altered fingerprints. In this method orientation field is extracted and then analysed. The extracted features are fed in to SVM Kernel for classification or detection of altered fingerprints. The proposed method is compared with existing techniques and it is noticed that proposed method gives better accuracy rate as compared to existing methods [13].

Anoop T. R. and Mini M. G. have proposed a method which detects altered fingerprints. Features such as minutiae density, ridge discontinuity or orientation discontinuity and Scars are extracted. Minutiae density map is extracted by using Parzen window method and ridge discontinuity map is obtained by comparing original image with enhanced image. Scars is used by adaptive average filtering method. These extracted features are fed to Support Vector Machine for classification. Obliterated and distorted fingerprints are correctly detected by using proposed algorithm but imitation requires further cross check with real altered fingerprints. 100 % distorted fingerprints are correctly detected while 87% of obliterated fingerprints are detected correctly [15].

3. Neural Network

Neural network is more accurately referred as Artificial Neural Network. It is a paradigm which works same as the biological neuron in the human brain works. It gives highly accurate result in case of precise and too complex data. It consist of several highly connected neurons which are collectively works in the decision making system or patterns recognition or detection. Neural network approach provides comparatively better accuracy. Neurons are trained first with all the possible inputs and then they are tested to check their performance accuracy. In this approach features are extracted and fed to neural network for classification. Classification is efficient but training neural network is highly complex and time consuming. It requires number of hidden layers for performing detection. It is trained with random values so it does not gives more precise output.

AFIS is widely used in variety of applications for detection and authorization of fingerprints. AFIS cannot detect altered fingerprints because of quality issue of altered fingerprints. If the fingerprint quality is better than only the AFIS gives correct output. A method is proposed which detects altered fingerprints by using Artificial Neural Network. Minutiae from the altered fingerprint are extracted as given as input to Artificial Neural Network. Artificial Neural Network classifies the fingerprint is altered or not as it is already trained [12].

4. Fuzzy System

Fuzzy system uses fuzzy classifier. Fuzzy classifier works on the fuzzy logic and fuzzy sets. It classifies the given input based on the training algorithm and training datasets. If the training data set is not available then the fuzzy classifier is trained based on the prior knowledge. To train fuzzy classifier it requires less time as compared with neural network. It gives more correct answer as it is train to work with precise values.

Fuzzy Classifiers can detect all the types of altered fingerprints i.e. Obliteration, imitation and distortion. The features are extracted from the ridge orientation field and fed to fuzzy classifier to detect altered fingerprint along with classification of fingerprint into different types. Combining the neural network and fuzzy system a new method is proposed which gives better performance than neural network [7].

Fingerprint is the most widely used Biometric Technology. If the fingers temporarily damaged then they reappears after it

heals. In this paper, a new algorithm is proposed to detect altered fingerprints based on the orientation field reliability and classify the alterations into different types. Singular points in the orientation field are extracted and fuzzy classifier is used to classify it as natural fingerprint or altered fingerprint. In natural fingerprint generally there is only one singular point present which is having highest pick value but in altered fingerprints there are more than one singular points present with small attitudes[18].

The existing fingerprint quality assessment software cannot detect altered fingerprints if the altered region is small or if the altered image quality is not so good. National Institute of Standards and technology Fingerprint image quality (NFIQ) is the software which is used in the existing fingerprint recognition technology. The NFIQ does not always detect altered fingerprints so it is important to modify the existing fingerprint quality assessment software to detect altered fingerprints. Dr. K. Latha have modified existing NFIQ algorithm by implementing neuro Fuzzy technique. They have used this technique because fuzzy systems are suitable for uncertainty and gives beset output when provided by uncertain information [7].

3. CONCLUSION

This paper summarizes the existing altered fingerprint detection techniques. Among the existing techniques for altered fingerprint detection, Support Vector Machine (SVM) method is widely used .SVM is simple to implement. Training and classification of SVM is easy as compare to existing techniques but it cannot work with large datasets.

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