INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT & MANAGEMENT

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SECURING A BIOMETRIC TRAIT: A CASE STUDY ON FINGER PRINTS

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ABSTRACT

Today's inevitable need is getting the correct information within specified time frame. For satisfying our requirement, it is very important to make the information secured from being damaged or tempered by any unauthorized user. There are many upcoming techniques in the field of information security. This paper enlighten us about possible methods of securing an information, starting from the most basic and traditional method i.e. password based, ID based and biometric trait based. As we all know that there are various possible biometric traits like fingerprint, hand recognition, iris based, ratina scan, face recognition etc. In this paper we have chosen finger print for further research. Based on the study about these methods i.e. password based, ID based and biometric trait based, the better method is also suggested. We also discuss various threats prevailing in the field of securing a biometric trait like latent print attacks, Trojan horse and fake feature attacks. We also state literature review as much of the work is already done in this field. After mentioning the already existing work, we discuss the current issues and challenges like robustness, performance, interoperatibility etc. We also discuss research objective to elaborate the work done in field of securing a biometric trait, followed by future scope and conclusion.

KEYWORDS

Physical Trait, Authentication, Steganography, Cryptography, Watermarking.

INTRODUCTION

From past many years, security has been a major concern, whether we talk about securing any product, information or identity of a person. Although many methods, techniques and algorithms are being implemented, some of them are good to a large extent but threats are still prevailing. Here, in this paper we will be concentrating on securing identity of a person. Again many minds are on their tracks to design a foolproof technique for the same.

As we know that there are various schemes like password based, ID based and physical trait[1] based.

In the password based scheme, every user is provided with a password. When he wants to access any resource, he is asked to submit the password which is matched with the one, stored in the database. Once there is a match the resource is accessible to the user, else not.

In case of ID based security, the person is given an Identity Card. This card contains the information about the person. At the time of request for any resource the user has to show the card, after checking the required credentials, user is authenticated to use that resource.

In physical trait[1] scheme the user provide an impression of finger print on the sensor which, along with the person's details, is saved as a template in the database. At the time of verification, the user is again asked to give the fingerprint sample which is then matched with already saved template. Depending on the result, the user is allowed to access the resources.

Apart from matching the sample, there are measures to check the authentication accuracy, namely FRR [2]and FAR[3].

As per the above discussion, it is analyzed that a system using physical trait is better as compared to password or ID based systems. Biometric systems possess a complicated architectural design, incorporating complex modules as it deals with different kind of data. Apart from being complicated these types of system face major problems, and root of all is Security. Securely saving a template, protecting it from unauthorized access, transferring the template without any errors and many more aspects are to being worked upon.

[1]Here physical trait means Finger print Sample

[2]FRR means that a genuine person is denied to access the resources

[3]FAR means that a fake person is given the access to the resources

EXISTING WORK DONE

Fengling Han et.al.[11], discuss a chaotic approach for encrypting fingerprint images by using a 2D chaotic sequence which is obtained from multi scroll chaotic attractors. For generating the private key, initial values of chaotic attractors are used.

Before the actual work is done, a large number of features of fingerprints including overall ridge flow pattern, ridge frequency, lacation and position of singular points, minutiae points, location of pores etc. she proposed two fingerprint authentication schemes. The first one is local fingerprint matching scheme where images are captured and processed at local system. Second is centralized matching scheme where image is captured at local site and are sent to central point via network, also used in ATM banking systems.

They also suggest different schemes that can be used to protect digital image/video from attacker i.e. digital watermarking and encryption. They also state that normal encryption algorithms like DES, IDEA and RSA are not suitable for biometric image encryption.

Juan M. Vilardy et.al. [14], in their paper discuss a digital algorithm i.e. fractional fourier transform to encrypt fingerprint data samples. In the process of encryption, a grayscale image of fingerprint is taken and it's placed as the phase of a complex exponential, then is transformed five times and multiplied in intermediate steps by four random phase masks statistically independent, thus to obtain the encrypted fingerprint.

On the other hand, in the process of decryption, the encryption procedure is applied in the inverse sense to the conjugated complex of the encrypted fingerprint, then is taken the negative of the phase of the resulting image of the decryption process and the original fingerprint is obtained this way that had been encrypted.

In the complete process nine keys are used constituted of five fractional orders and four random phase masks.

The Mean Square Error (MSE) between the input fingerprint and our decrypted fingerprint is calculated to validate the reliability of this algorithm.

Colin Soutar et.al.[9] emphasized on understanding the interface between biometric systems and general security systems is critical for the successful deployment of biometric technologies. They states that at the time of sending private/ confidential data, the problems such as identity, replay and hill climbing attacks must be avoided.

Daesung Moon et.al.[10], state that biometric-based authentication can provide a strong security guarantee of the identity of users. They propose a secure and efficient protocol to transmit fingerprint images from a fingerprint sensor to a client by exploiting the characteristics of the fingerprint images. To reduce the computational workload of applying the algorithm on full finger print sample, they suggest to apply the encryption algorithm to a nonce for integrity and to a specific bitplane of each pixel of the fingerprint image for confidentiality. Experimental results show that the integrity and confidentiality of the fingerprint images can be guaranteed without any leakage of the fingerprint ridge information and can be completed in real-time on embedded processors.

TYPE OF ATTACKS

There are various types of severe attacks to the components of biometric systems.

Latent print attacks. Sometimes, we can extract previous finger print features from the sensor itself, as the impression of finger is left on the surface of sensor which can be activated at later point of time.

Trojan horse virus may also attack computer systems, therefore it is advisable to perform any kind of biometric processing in a separate hardware outside the system.

Fake feature attack, more commonly known as Spoofing, is also a kind of attack in which mechanical copies of the feature are designed, which is shielded by liveness detection technique to a large extent.

Irrespective of the sensor, a stored template can be replayed into the system i.e. a copy of finger print can be replayed in the database.

Being easy to use, easy to install and of requiring less investment, fingerprint analysis is majorly in practice as compared to other biometric techniques. In order to promote this technique and for enhancing its reach to many other areas, first an increased security is demanded.

There are various techniques to provide impart security such as cryptography, watermarking and steganography.

S.Brindha and Ila.Vennila (2011), states that Cryptography is a process of hiding information into an unintelligible (encrypted) form for the purposes of secure transmission. Through the use of a "key" the receiver can decode the encrypted message (decrypting) to retrieve the original message.

Stenography improves on this by hiding the fact that a communication even occurred. The message m is imbedded into a harmless message c which is defined as the cover-obect. The message m is then embedded into c, generally with use of a key k that is defined as the stego-key. The resulting message is then embedded into the cover-object c, which results in stego-object s. Ideally the stego-object is indistinguishable from the original message c, appearing as if no other information has been encoded.

While cryptography focuses on methods to make encrypted information meaningless to unauthorized parties, steganography is based on concealing the information itself.

Watermarking is very similar to steganography in a number of respects. Both seek to embed information inside a cover message with little to no degradation of the cover-object. Watermarking however adds the additional requirement of robustness. An ideal steganographic system would embed a large amount of information, perfectly securely with no visible degradation to the cover object. An ideal watermarking system however would embed an amount of information that could not be removed or altered without making the cover object entirely unusable.

Watermarking technique provides solution to ensure the validity of biometrics; proposed scheme is composed of three parts: watermark embedding, data embedding and data extraction. They also states the difference between encryption and watermarking highlighting the advantages of using watermarking. Firstly, watermark is imperceptible. Secondly, the watermarks and the works they embedded in are inseparable.

CURRENT ISSUES AND CHALLENGES

As we all know that, the output of any system depends upon the input provided. Similarly, the result of a fingerprint recognition system depends on the quality of fingerprint sample inputted. The fingerprint image depends on various factors like skin conditions, sensor conditions etc. A poor quality image results in missed features which in turn along with lack of robustness, degrade the performance of the system. Thus accepting a sample of good quality and maintaining its validity is a major challenge.

Sensor interoperatibility is also a major area of concern. Different vendors are designing different kind of sensors on the basis of customer's needs and preferences. But once we talk about comparing the samples taken from different sensors, we are restricted to do so. Thus changing a sensor may affect performance of the system. Thus to solve this issue, common data exchange formats should be developed to facilitate the exchange of feature sets between vendors.

Today, the fingerprint sensors are embedded in various devices like mobile phones and PDAs to provide security. But the sensor, being of small in area leads to less overlap between fingerprint positions of same finger which hampers performance of the system.

RESEARCH OBJECTIVE

After studying all the aspects, we have analyzed that there are many algorithms designed in this filed. I have decided to study Multi-algorithm multibiometrics System, where as the name suggest, more than one algorithm is implemented to identify the user. Based on the study, my aim is to design an optimized algorithm to make a finger print sample more secure, so that the scope of finger print recognition system could be widened.

FUTURE SCOPE

There are some high security areas where security based on one trait is not sufficient. The logic behind is, if anyone loose the particular trait e.g. person loose his hand then the system will not be able to recognize the user, even if he is the authorized one. In this paper we have emphasized on security aspect of Finger prints which could be extended to providing security on the basis of other Biometric traits like hand, face, iris, retina etc. Work can also be extended to combining more than one physical feature, depending on the requirement, to provide security.

CONCLUSION

As we have seen that out of many possible methods of information security i.e. password based, ID card based and biometric based, later is better. On one hand, if we consider simplicity and installation, then former method is chosen. But we consider better security, then biometric method should be the choice. Thus the implementation of technique depends upon granularity of secrecy of information and the level of security needed. Apart from the fact that in biometric trait method there are some threats, we can believe that those can be worked upon. There are many great minds which are trying to impart security with the techniques like watermarking, steganography and cryptography. On the basis of literature survey we can conclude that watermarking is comparatively simple to implement. If anyone wants to implement any of the biometric trait method then there is different kind of data would be studied. Such as, in fingerprints, to understand the features one should have in depth knowledge of minutiae, ridges patterns etc. We have also discussed the current issues and challenges, which emphasized on robustness, performance and interoperatibility. The day when all hindrances are over, biometric technique will be used all over the world and that too in all the fields.

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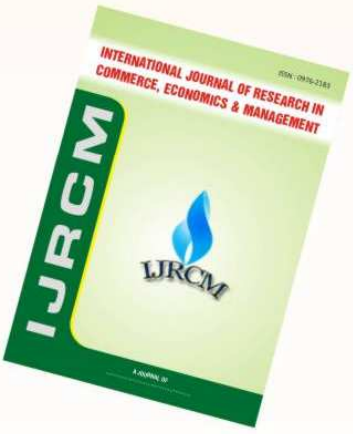
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