International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 2 Volume No.7 March - April – 2023
DOI:10.46647/ijetms.2023.v07i02.056 ISSN: 2581-4621

EFFICIENT AND PRIVACY-PRESERVING ONLINE FINGERPRINT AUTHENTICATION SCHEME OVER OUTSOURCED DATA

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ABSTRACT
The fingerprint recognition approach uses a variety of techniques, each of which is based on particular criteria. Finding an effective method for fingerprint recognition is the goal of this work. The goal of this project is to provide a straightforward, high-performance fingerprint recognition method. This strategy consists of two main phases: The first step is actually collecting data from samples of human fingerprints, and the second step focuses on designing and implementing a highperformance fingerprint recognition method. The feature extraction phase, in which numerous levels of the two-dimensional discrete cosine transform (D-DCT) are utilized to generate highperformance features, was the primary focus of the implemented strategy. By combining the functions of the right and left thumbs, this strategy is carried out. According to the findings, this method achieves a high level of recognition accuracy. Choosing the security architecture and policies for a system is a difficult task that must be guided by an understanding of user behavior in the proposed work to Improve data security against darker we. Shamir cryptography is the subject of our free fuzzy vault-based fingerprint cryptosystem that makes use of highly discriminative pairpolar (P-P) minutiae structures. Our system's use of fine quantization makes it possible to use a well-known, conventional minutiae matcher right away and retain a significant amount of information about a fingerprint template. The proposed fingerprint cryptosystem outperforms other minutiae-based fingerprint cryptosystems and is highly secure when compared to a few publicly available databases.

1. INTRODUCTION

There are two types of human biometrics: physiological and behavioral biometrics, respectively. Each individual has biometric characteristics that can be used to identify them. Things like a person's face, fingerprint, iris, finger shape, and so on cannot change over time. Time can alter a person's signature, voice, typing rhythm, speaking, and other behavioral traits. The biometric process provides a high level of security in the authorization process between legitimate people and unauthorized people. It matches the information with data that has been stored, which is called verification, and then identifies the person who deals with identification. While the four fundamental steps of a biometric system are as follows: comparison, collection, extraction, and decision The process of collection involves using a sensor to capture the biometric characteristics, converting them to a digital format, and the process of extraction involves taking the digital data and transforming it into detective features in a compact template. The best result will be obtained by comparing the result to store objects during the comparison process. The fingerprint is a crucial method that is frequently used for personal identification.

1.1 BIOMETRIC SYSTEM

A biometric system is a technology that uses biological data to identify human body features based on physiological or behavioral characteristics. Expertise is able to construct a robust method for security systems using biometric human characteristics. Because biometric systems can't be taken or lost, they're more useful in today's recognition technologies. because traditional security measures like ID cards and passwords aren't strong enough for today's technology-driven world.

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Verification and identification are the two fundamental principles upon which the biometric system is based. Check in biometric frameworks is contrasting from ID, as far as looking at the acquired biometric data against the saved subjects which relates to all clients in the saved data set, while, confirmation stands to correlation between required personalities with the particular joined formats.

1.2 FINGERPRINT RECOGNITION

The process of deciding whether or not two sets of fingerprint ridges belong to the same person is called fingerprint recognition. has demonstrated that it is unable to match fingerprints that are identical to those of two people around the world. In many different fingerprint applications, the style guides minutiae, correlation, and ridge pattern are utilized. One of the most widely used biometric systems in contemporary technology is fingerprint recognition. Depending on the requirements of an application, a biometric system can be used in verification mode or identification mode. Because the system process performs a one-to-one comparison, verification is a simpler and quicker process. The system process makes a one-to-many comparison between the features of the query fingerprint image and the fingerprint images in the database.

2. LITERATURE REVIEW

2.1 IDENTIFICATION OF FINGERPRINT USING DISCRETE WAVELET TRANSFORM IN CONJUNCTION WITH SUPPORT VECTOR MACHINE

Shahid Akbar proposes in this work [1] that fingerprint recognition is mostly used in biometric and security systems that can be used for a variety of safety measures in a variety of areas of the national defense organization. Given the significance of the biometric system, numerous efforts have been made to recognize fingerprints; however, there are still some issues that call for additional investigation and focus. In this regard, we attempt to develop a robust and dependable fingerprint recognition biometric system. The Discrete Wavelet Transform, Principal Component Analysis, and Discrete Cosine Transform are the three discrete feature extraction techniques utilized in the creation of the proposed computational model. There are two distinct types of classification hypotheses used, and they are: K-nearest neighbor and support vector machine (SVM) Three distinct benchmark unique finger impression datasets and 10-folds cross approval are applied to assess the presentation of the proposed model. Using all three benchmark datasets, SVM has demonstrated outstanding performance, as shown by the empirical results. It has been determined that the predicted model may be a useful and high-throughput tool for security-related fields and academia. The Greek word for "life to measure" is the origin of the term "biometric." The use of biometrics to identify humans is concerned with a person's physiological or behavioral characteristics..

2.2 STATE OF ART ON FINGERPRINT RECOGNITION

U. U. Manikdurge has proposed a biometric system that uses a person's behavioral and physiological biometric parameters to identify them in this work [2]. The recognizing system of each fingerprint focuses primarily on local ridge features like ridge endings, minutiae, core point, delta, etc. However, due to variations in skin and impression conditions, fingerprint images are of poor quality. When it comes to personal identification, fingerprint recognition is thought to be the most popular and dependable method for comparing fingerprints in a database. For accurate recognition results, a few methods and algorithms are discussed. The more important step in fingerprint matching is to extract the nuclei. In order to determine which method is more secure and reliable for fingerprint recognition systems, this study provides an overview of various feature extraction and matching algorithms. Based on one or more physical or behavioral parameters, biometrics reveal the individuality of humans. Because biometrics is a feature that is unique to each person, there is no need to remember passwords or carry any identification documents.

2.3 AN EFFICIENT APPROACH FOR FINGERPRINT RECOGNITION

According to Dr. R. Satya Prasad's work [3], fingerprints have been one of the most widely used methods for human recognition for more than a century; Only recently have automated biometric systems been made available. The majority of biometric systems collect observations of an individual's biometric using everyday sensors like digital cameras; Analyses of other sensors would

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be required. The purpose of this work is to develop an effective method for fingerprint recognition that can be implemented in a number of steps; fingerprint feature extraction follows fingerprint image acquisition, fingerprint isolation, and fingerprint enhancement. The implemented system is believed to have tested two fingerprint images for the left and right thumbs, with satisfactory results. In situations where it is necessary to identify an individual, biometrics can be utilized. Applications range from physical access to a secure office or building to logical access to a personal computer. They can be utilized in an assortment of assortment conditions as ID frameworks. Applications involving accountability also make use of biometrics, such as recording the biometric identities of individuals signing for a piece of equipment, boarding an airplane, or the chain of evidence. Obviously, controlled environments like offices and laboratories give biometrics a better chance of working than uncontrolled ones like the outdoors.

2.4 AN EFFECTIVE ALGORITHM FOR FINGERPRINT MATCHING

One of the most crucial steps in automatic fingerprint identification systems (AFIS), according to Ying HAO's work [4], is fingerprint matching. Because of the numerous nonlinear deformations that are frequently observed in fingerprint images, conventional approaches treat this issue as point pattern matching, which is in essence an intractable problem. In this article, we propose a viable finger impression matching calculation in view of blunder spread. First, the initial correspondences, or pairs of matching minutiae, are found using ridge information and Hough transformation to estimate the alignment parameters and the common region between two fingerprints. The correspondence and the matched minutiae pairs that surround it are then included in a Matched Set. The idea of error propagation serves as a guide for the subsequent matching procedure: the matching mistakes of each unparalleled particulars are assessed by those of its most important neighbor details. We use a flexible propagation strategy to avoid mismatched minutiae pairs leading the process astray. The results of our experiments show that our algorithm can handle non-linear deformation.

2.5 A NOVEL THINNING ALGORITHM FOR FINGERPRINT RECOGNITION

Muzhir Shaban Al-Ani has proposed in this work [5] that numerous published algorithms for fingerprint recognition have varying accuracy rates. In order to develop an effective new system, this work examines the current fingerprint recognition algorithms in order to enhance the proposed fingerprint algorithm's performance. The thinning process is the primary focus of the proposed fingerprint algorithm. Based on optimal thinning, fingerprint enhancement and the extraction of minute details. The output results show that the fingerprint recognition pattern has improved significantly. The Greek words bios (life) and metrikos (measure) are the origins of the term biometric. It is common knowledge that humans intuitively recognize one another based on a person's face, eyes, finger, iris, gait, or voice. Recognizing humans based on their physical characteristics has become more intriguing in new technologies and applications due to the fact that a wide range of applications today require trustworthy verification schemes to verify an individual's identity. Passwords and ID cards have traditionally been used to restrict access to secure systems, but these methods are unreliable and easy to hack. A biometric can't be borrowed, stolen, or forgotten, and it's almost impossible to fake one. biometric identification using a fingernail impression of the ridges in the skin; frequently utilized as proof in criminal examinations.

3. EXISTING SYSTEM

The images produced by these gadgets are typically of a smaller size due to the small sensors that are embedded within them. These devices frequently acquire multiple partial impressions of a single finger during enrollment to make up for their small size. This ensures that at least one of the impressions will successfully match the user's image during authentication. Additionally, the impressions pertaining to multiple partial fingers are associated with the same identity (i.e., one user) in some instances, allowing the user to enroll multiple fingers. If the partial fingerprint obtained during authentication matches any of the stored templates, the user has been successfully authenticated. For a significant number of users, this project investigates the possibility of creating a "Master Print," which is a real or fake partial fingerprint that coincidentally matches one or more of

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the stored templates. It is indeed possible to locate or generate partial fingerprints that can be used to impersonate a large number of users, according to our preliminary findings on an optical fingerprint dataset and a capacitive fingerprint dataset.

4. PROPOSED SYSTEM

Fingerprint image database, fingerprint image localization and 2d-DCT computation, estimation of the region of interest, feature computation, feature database, distance computation, and matching are the functional blocks of the proposed system. For the purpose of finger geometry and fingerprint feature extraction, the pose corrected range and intensity images are processed to locate regions of interest (ROI). It is possible to base the in-depth description of this method on the detection of interfinger points. It very well might be noticed that the interfinger focuses can be dependably situated as there can be no cross-over between fingers in the posture remedied finger pictures. The methods used in this work for feature extraction are briefly described in the following section. Using pair-polar (P-P) minutiae structures, a security-enhanced alignment-free fuzzy vaultbased fingerprint cryptosystem was proposed. Based on their minutiae, the global minutiae matching algorithm matches two fingerprints. For security upgrade, every P seemingly trivial details structure is changed prior to being encoded into the fluffy vault. A two-level secure sketch a fluffy vault and Shamir's mystery sharing plan is utilized in the encoding method.

The proposed approach performs better than 2D-DWT. Since the majority of DCT coefficients have a negligible magnitude, feature extraction does not employ them all. Negligiblesized DCT coefficients are eliminated.

4.1 PRE-PROCESSING MANAGER

This module is used to analyze finger pose variant images by preprocessing them so that the finger can be identified in the acquired finger images. These images are registered and correspond pixel for pixel because the intensity and range images of the finger are acquired close to simultaneously. As a result, we use Otsu's threshold to binarize the intensity image to locate the finger. Morphological open operators, which remove isolated noisy regions, further refine these binary images. Finally, the set of finger-related pixels is thought to be the most connected component in the final binary image. We initially experimented with an interfinger-based method to locate the finger center. Pre-processing of fingerprints: This step has many phases, starting with the individual fingerprint separation for each person and continuing with the application of a simple low pass filter to remove noise from images. then resizing all fingerprint images to be the same size to make the next processing step easier.

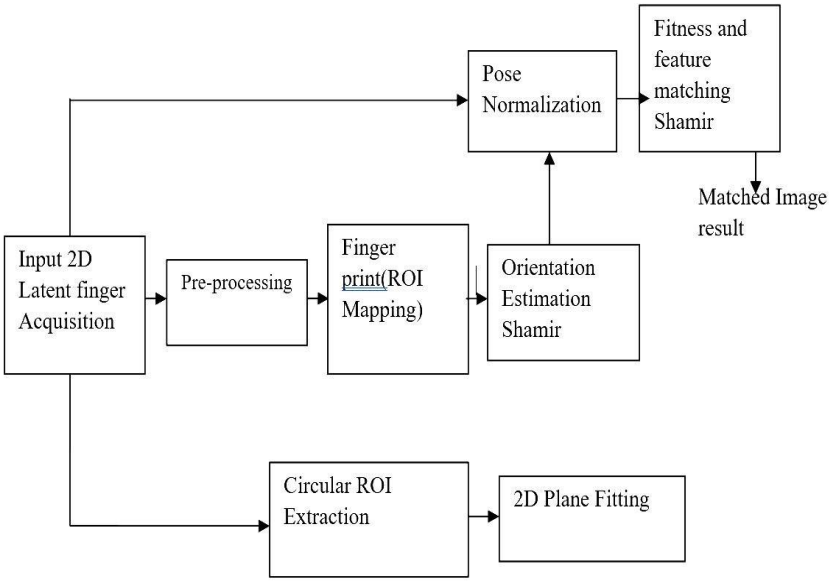

Fig.1.Overall system architecture

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4.2 2-D FINGER GEOMETRY MAPPING

The binarized intensity images of the finger are used to extract two-dimensional finger geometry features in this module. This work makes use of the finger lengths and widths, perimeter, area, and width features of finger geometry. A feature vector is created by adding together measurements taken from each of the four fingers. The Euclidean distance is used to calculate the matching score between two feature vectors from a matching pair of fingers. Due to occlusion around the finger edges, the proposed pose normalization method loses important information in the finger (finger) geometry features. When the finger is rotated about the axis, the occlusion is particularly sever . because the scanner cannot see much of the finger around its edges, causing a significant loss of information during pose correction. As a result, the pose-corrected intensity and range images can only recover a portion of the finger region of interest. Grayscale images from color images: Grayscale image generation is the focus of this step. A color to gray converter is used to produce gray images that are ready for the subsequent processing step.

4.3 2-D FINGER PRINT ANALYZER

In this module, highly distinguishable characteristics for personal identification are provided by two-dimensional finger prints that are extracted from range images of the finger (the region between finger valleys and the edge). Highlights contained in the 2-D unique mark are basically neighborhood surface subtleties as profundity and arch of finger lines and kinks. The previously developed Surface Code 2-D finger print representation is used in this work. The computation of the shape index at each finger surface point serves as the foundation for this concise representation. Every data point can be categorized into one of the nine surface types based on the value of the shape index. A Surface Code representation is then produced by binary encoding the index of the surface category with four bits. The normalized Hamming distance serves as the foundation for determining the degree of similarity between two feature matrices (Surface Codes). Acquiring Fingerprints: This step begins with the collection of traditional fingerprint data, which is then organized and converted into digital fingerprint images for processing. A smartcard contains a set of user-specific chaff minutiae features that are selected at random and used at each acquisition. A fixed-length hardened feature is created by scrambling the chaff minutiae with the template set. The proposed hardening scheme has no effect on the graph-based dynamic matching algorithm, which nevertheless operates as though it were utilizing only the original query and template features. Biometric hardening reduces error rates to zero, as demonstrated by our experiments, with a separation of several orders of magnitude between genuine and impostor populations.

4.4 POSE ANALYZER AND MATCHING FINGER PRINT EXTRACTION

We developed our own database employing a commercially available 2-D digitizer in order to capture and store 2-D finger poses in a variety of poses for storage in a database. Finger images are acquired contact-free. This work uses the same image acquisition system that was described in. Students who volunteered to provide their biometric information made up the majority of those who took part in our institute's process of collecting data. Right finger images from 114 subjects, in both 2-D and the corresponding 2-D, are currently stored in the database. Subjects were instructed to present their finger in five distinct positions in order to introduce significant pose variations into the database. Enhancement of Fingerprints: In this step, the histogram equalization technique is used to improve the image. By using image enhancement, an efficient method of improvement, the image's details will be clear and easy to understand, and the image will have good characteristics that provide useful data for the subsequent step.

5. CONCLUSION

Based on real valued DCT, we have proposed a novel method for fingerprint matching that reduces feature dimensionality. We have demonstrated the way that the DCT can be effectively used to remove the educational and discriminative highlights from the little locale of a unique mark picture. The feature extraction methods that are currently in use fall short of what our proposed method achieves. According to our comparison, the compact feature vector performs better than the DWT

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method in terms of recognition rate and ROC than our proposed feature dimensionality reduced approach. When compared to DWT, our proposed DCT-based feature extraction method has a higher computational complexity. However, the computational complexity of the DCT algorithm can be roughly equal to that of the DWT algorithm.

6. FUTURE ENHANCEMENT

The biometric feature and the user's password provide two layers of security for this system. Due to the irrevocability property, a lost fingerprint cannot be used again in the current system. However, with the user password layer, if the user's fingerprint is stolen, he can choose to use a different password with the same fingerprint. However, because the password length in our system is between six and eight characters, an attacker must still guess the range and launch a dictionary attack. The proposed system can't be broken into because it uses the 2D-DCT encryption scheme. As a result, the proposed system generates a new 128-bit key that will be used for further encryption and decryption rather than directly using the fingerprint's 128-bit key through this varying level of security feature.

7. RESULT

algorithm	accuracy
existing	75.82
proposed	80.97

Table.1.Accuracy comparison between existing and proposed system

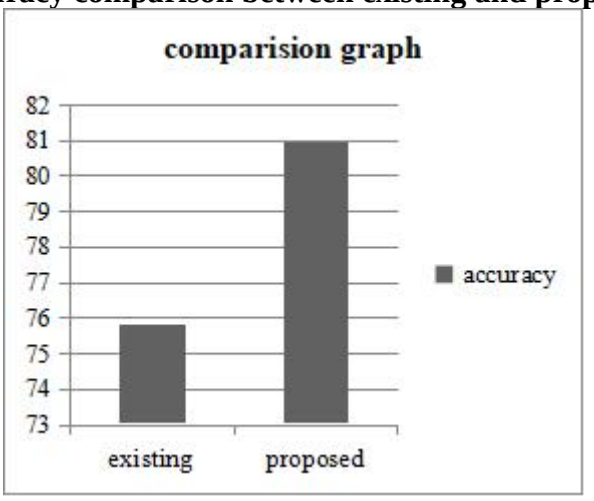

Fig.2.Accuracy comparison graph between existing and proposed system

An individual's unique patterns of ridges and furrows on their fingers, palms, or feet are compared and analyzed during fingerprint analysis in order to identify them. The process of comparing the fingerprint patterns obtained from various sources to determine whether there are any similarities or differences involves the process of analyzing the fingerprint results. There are two main steps in fingerprint analysis: identifying and confirming Verification is the process of confirming an individual's identity by matching their fingerprint to their known identity, while identification is the process of matching an unknown fingerprint to a known one. Experts employ a variety of approaches, including digital imaging, computerized systems, and visual comparison, to evaluate the fingerprint examination results. To arrive at a conclusion, they look for distinctive characteristics like bifurcations and ridge endings. The results of fingerprint analysis can be used for a variety of purposes, including border security, background checks, and criminal investigations. Despite the fact that fingerprint analysis is a highly effective method for identifying individuals, it is not foolproof

DOI:10.46647/ijetms.2023.v07i02.056 ISSN: 2581-4621

and may occasionally produce false positives or false negatives. This is an important point to keep in mind.

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