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The new hand geometry system and automatic identification

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ABSTRACT

For the past decades an extensive amount of time and effort has been consumed for the research and development of biometric-based recognition systems. One such system is the one that can recognize based on hand geometry. The objective of this thesis is to explore the usage of hand geometry for developing a hand geometry recognition system. This paper proposes a system performing automatic recognition without the use of specific hardware. The system emphases on executing feature extractions from a typical database and then developing a neural network classifier based on back-propagation architectures with various exercise methods. Features are dug out by the use of morphological (segmentation) operation. Our Experiments were carried out on 500 images (50 persons, 10 images each) under distinctive conditions with possible deliberation of scaling, Translation, Rotation, Color and Illumination modification. The accurate recognition rate is about 96.41 % for the matching of artificial neural network which is calculated by the formula average of sum of errors divided over the number of images.

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1. Introduction

The word Biometrics is acquired from the old words of Greek i.e. bios means "*life*", metron means "*measure*". This is used to define two fields of study and application that are very different. The older field of biological application studies involves forestry, collecting, synthesizing, analyzing and managing measurable data on biological communities such as forests. Biometrics has been studied and applied for various generations in reference to biological sciences and is to some extent regarded as "biological statistics"[1].
At recent time, the meaning of the term has been widened to include studying techniques for people's recognition through at least one inborn physical or behavioral qualities. For behavioral biometrics some researchers invented the word behaviometrics like mouse gestures or typing rhythm where a continuous investigation is possible without disturbing or interfering with the activities of end user [2].

Common Human Biometric Characteristics

Biometric characteristics can be categorized into two main fields, as characterized in figure (1):

- Physiological are associated with the body`s shape. The oldest features used for over a century are FB fingerprints. Face recognition, iris recognition and hand geometry are additional examples .
- Behavioral are associated with a person's behavior. The signature is the first characteristic that is still widely used today. The study of keystroke dynamics and voice is more modern methodologies .

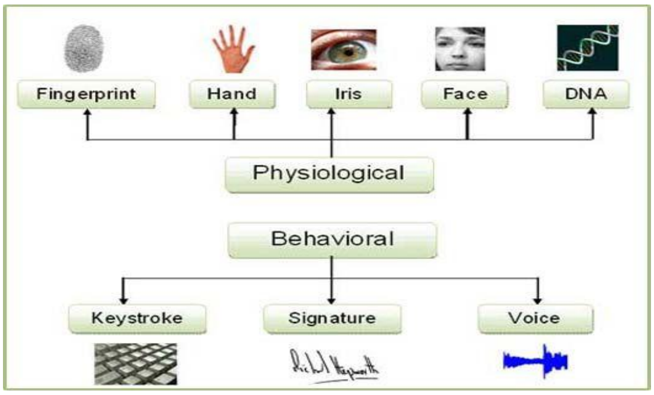


Figure 1. Classification of Biometrics.

Voice can definitely be considered a physiological attribute given that each individual has a dissimilar pitch. Although the assessment of voice is primarily dependent on investigating a person's way of speaking, generally passed on conduct [3].

Other biometric approaches are being developed, examples are those that depend on gait (walking path i.e. step), hand veins, retina, facial thermo gram, ear canal, DNA, odor and fragrance and palm prints. Table 1 looks at certain characteristics of various biometric developments. It is interesting to see one can not guarantee that a given innovation will surpass substitute ones for each of the outlooks [4].

Table 1. Comparison of different biometric technologies (L=Low, M=Medium, H=High)

Characteristic	Face	FB	Speech	Hand	Iris	Sg.
Ease of use	M/H	H	H	H	M/H	H
Accuracy	M	H	M	M	H	M/H
Acceptability	H	M	H	M/H	M/H	H
Security	M	H	M	M	H	M/H
Permanence	M	H	M/H	M/H	H	M/H

2. Biometric technology

2.1 Fingerprint identification technology

A fingerprint includes multiple valleys and ridges on the finger’s surface. Ridges are the finger's upper layer of skin. Valleys are the lower sections of fingers. The ridges are supposed to constitute minute points: ridge bifurcations (where the ridge splits into two) and ending of ridge (where the ridge ends). There are various kinds of minutiae, including dots (very small ridges), occupying a central space between two momentarily divergent ridges), bridges (small ridges joining two longer adjacent ridges), islands (ridges that are slightly longer than dots), spurs (a notch bulging from a ridge), crossovers (two ridges crossing each other), and ponds or lakes (empty spaces between two temporarily divergent ridges) [5,6].

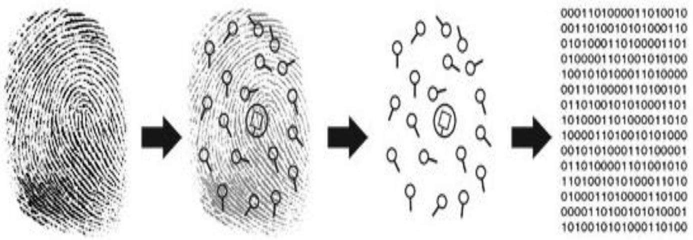


Figure 2. Fingerprint Identification Technology.

The furrows and ridges patterns and the points of minuatiae are used to ascertain the fingerprint individuality. Five major patterns of fingerprints are available: tented arch, arch, whorl, right loop, and left loop. 60% of fingerprints are consist of loops, 30% are of wholrs, while arches make 10% see figure 2. Fingerprints are generally thought to be unique, dermal ridge characteristics of any two fingers are not the same [7].

2.2 Hand Geometry Identification Technology

Hand geometry is a biometric kind that discriminates people from their hands attributes. Geometry of hands peruses examines numerous measurements of the hand of a client and compares these estimates with the client's database [8]. Since the mid-1980s, some practical gadgets of hand geometry were made. The first biometric to be used electronically to distinguish customers is hand geometry. It stays noticeable; normal applications include activities using access control, time and participations. Iris recognition and fingerprinting for high-security applications remain the preferred innovation as geometry of hand is not considered as original as fingerprints or irises. Hand geometry works perfectly when used along with different types of ID, for example, recognizable proof cards or individual distinctive proof numbers. Hand geometry isn't appropriate for supposed one to several applications, in which a client is recognized from his biometric with no other identifiable proof in large masses [9].

Figure 3. Hand Geometry Identification Technology.

2.3 Biometric Systems

Enrollment and test are the main procedures a system can perform are. During the enrollment process, a person's biometric information is stored. Biometric information is detected during the test and matched with the data saved. By noting, security of storage and retrieval of such systems is critical to make the biometric system robust [10].

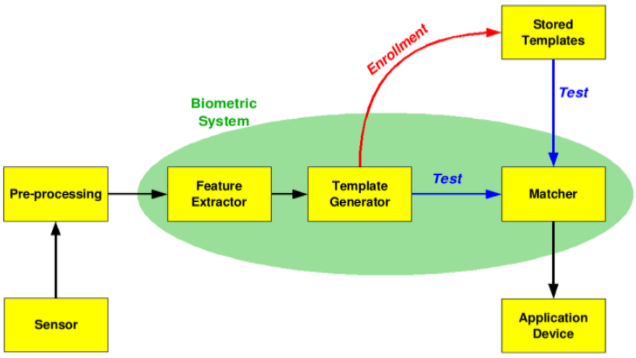


Figure 4. The block diagram basic modes of a biometric system.

Above is a simple biometric system block diagram. When such a system is combined with technology of telecommunications, biometric systems can be called a telebiometric system.

2.4 Biometric Functions

A biometric system can deliver two functions as follows [11]:

- Using a combination of smart card, username or ID number, verification authenticates its users. For verification, the biometric pattern taken is matched to that stored either on a smart card or database against the registered user.
- Identification validates its users without smart cards, identification numbers or usernames from just the biometric characteristic. The template biometric matches all database records and returns the nearest match score. The nearest match within the allowed threshold is believed to be individual and verified.

2.5 Biometric System performance (Evaluation of a Biometric System)

To measure the biometric system efficacy, normally following parameters are in use [12]:

- False match rate (FMR) or false accept rate (FAR): is likelihood that system will erroneously declare a victorious match among the input pattern and a database pattern that does not match .
- False non-match rate (FNMR) or false rejection rate (FRR): it is likelihood that system will erroneously declare the matching pattern of input in the matching database template.
- Relative operating characteristic (ROC): The matching algorithm generally uses a threshold to execute a decision.
- Equal error rate (EER): The accepting and rejecting error rates where both are equal .
- Failure to enroll rate (FTE or FER): The data input percentage is deemed unacceptable and cannot be successfully entered into the system .
- Failure to capture rate (FTC): the likelihood that a biometric trait will not be detected by the system when presented correctly in automatic systems.
- Template capacity: The maximal number of sets of data in the system can be entered.

2.6 Comparisons of Various Biometric Technologies

- In terms of the following constraints, it is understandable whether for biometrics human trait can be used [13]:
- How capably the biometric differ from other is called uniqueness.
- How capably a biometric resistance to aging is measured by Permanence.
- How easy acquisition is carried out for measurement is called collectability.
- Performance accuracy, technology use robustness and speed.
- Acceptability is defined as the extent of authorization of technology .
- Circumvention is defined as the substitute ease usage.

3. Related work (Hand geometry and Hand shape)

Every single human in every aspect; there were categorized thirty widespread hand geometry features. These characteristics are cautious but can be clarified as comprehensive highlights of contactless 2D hand geometry [14]. Measures characterized by creators can be easily seen in Figure (5).

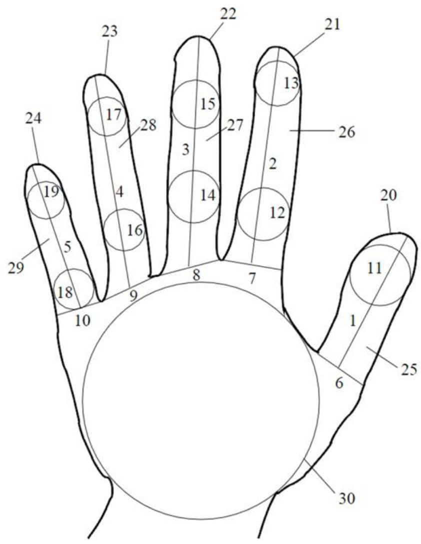


Figure 5. Hand geometry features according.

The geometry which is dependent upon recognizable proof frameworks is making use of geometric divergences in the human hands. Commonplace highlights include finger length and width; position of the palm and fingers, how this is the hand, etc. There are no frameworks that take into account some non-geometric highlights (such as skin color). Pegs used by a few scanners are also useful in deciding the axes required for component extraction. Figure .6 shows a model where the hand was the vector with approximate results and 16 attribute focuses were removed [15].

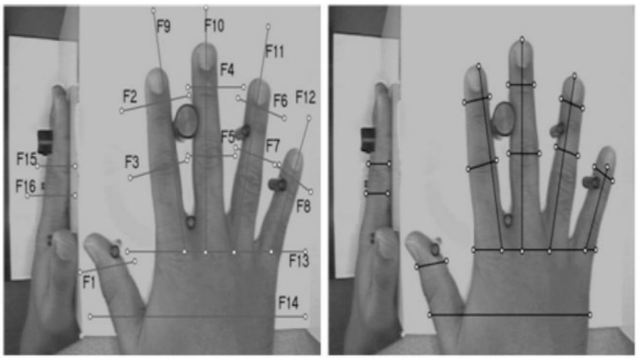


Figure 6. The sixteen axes along which feature values are computed.

In researches [15-16], hand geometry-based check framework was developed and connected to a model web framework. The framework used hand features i.e. the finger's width and length, the angle ratio of the fingers or palm, the hand's thickness, and so on to leave non-geometric skin color features of the hand. The trial results of the framework were agreeable. The sample consisted of 500 pictures from 50 clients, where 10 pictures from every client were used. Only 360 of the 500 images were used to test the geometry of hand framework and the remaining 140 were rejected due to the erroneous arrangement of the customer's hand on static hand recognition. For examining the picture of the correct hand, a report scanner was used and around 30 characters were removed. The discarded features were finger length (e.g. thumb, record, center, ring and last finger), finger width (all fingers), upper and lower circle span of the finger, finger edge, etc. This was also tested on a database of 714 pictures of hand from 70 people, recognizing that acknowledgment of hand geometry frameworks can be used as medium level of security applications.

In the other work [17], a calculation was carried out which considered shape and movement of hand with hand division determinedly non-segregated into the system. The division of hand is rigorous so that even confusing foundations are covered off and only the hand picture was left with an undeviating foundation. Each gesture of hand is converted into a combination of pictures of hand and then comparing the pictures and placing different sequences of pictures in a database to build a match. This was successful in achieving the recognition rate for 161 test successions was 93.2 percent (805 images), each group consisted of 5 pictures) While the success rate for the most expressive features (MEFs) was 87%. In the meantime, the article [18][19], established a real-time method of image realization which could reliably identify vigorous hand motions, irrespective of particular varieties of human hand. The signals are recognized based upon the shapes available and the notion of movement. For motion realization, the structure is dependent on HMMs and a Kalman channel is used to follow the hand. The frame works in such a way that the hand shape recognizer is beckoned to distinguish the new hand shape when a change in hand shape is noted; the tracker is also installed. Therefore, the tracker's return is perceived. As a result, the realization rates for all customers and all the various signals were above 90% on average. These were largely used in the recognition of appearance-based hand motion. This left room for the investigation of different techniques that could be used to examine the design. Furthermore, this can be connected successfully to the speech realization .

In the same regard was suggested in [20-21], a record verification process is finished by obtaining passwords which are appeared communication via gestures or motions. A two-digit password is allotted to a document. The info is caught utilizing a basic web camera and prepared utilizing naming calculation and if a match happens, the document can be seen by the client and if a confound happens, get to is denied in the proposed framework the information hand signals are caught utilizing a basic web Camera. The customer also has password/pin to bolt the record. The hand motion pictures are changed over to twofold pictures and after that foundation subtraction is performed with the info pictures and a foundation picture. The subsequent picture got from the subtraction is handled utilizing marking calculation. In the other hand, new system that utilized dynamic shape models to extricate hand characteristics. It takes in account the skin hand color dispersion and edge discovery to determine a reliable hand shape In the HSV color space, the skin color is translated that the human skin color tint (H) estimates are within invariant extents. After fragmentation of the hand and removal of the original image.

Paper [22-23] explores hand geometry acknowledgment framework in biometric field. Hand geometry acknowledgment framework is employed in several applications and in the fields of security. Direct calculation and experimental gadget were performed to identify the user from the camera through their hand picture. For example, finger's length, wrist width, and palm's length and width and center finger point thickness along with their proportions are used to fit the geometric qualities very well. All acquired information is stored in central database for investigation. The proposed work [24] presents the best way to use the state of the palm to remove features making use of extremely basic calculations which depends on the man's shape, palm size and finger lengths and widths. The proposed design will work with sloppy hands because a little amount of information is required to for the most part distinguish. This framework is (i) less than most other frameworks. (ii) Has low levels of FTE. (ii) Easy to use. (iii) Unnecessary .

On the other hand, the paper [25], proposed new method based on the palm print to provide solution for identity verification of individuals. This work brought in view a new approach to the extraction of hand characteristic. The key features are based on the image`s texture and color information both. This technique can be used in handhelds devices for the verification of user due to the reason that this solution is feasible for devices which have limited computational resources. Authors [26-27] state that extraction of features is the critical part of the system of recognition. They suggest that discrete two-dimensional wavelet transformation (2D-DWT) be used as a classifier for euclidean distance and extraction of feature. In the suggested method, additional blocks are not used to take care of the effect of noise; investigation of the deviation in the recognition performance with the existence of various amounts of additional Gaussian noise is also carried out. As anticipated, it is found that with the rise in strength of noise that is with dropping signal-to-noise-ratio (SNR), the accuracy of recognition acquired by the suggested method reduces. The discrete cosine transform (DCT) was suggested on the basis of texture shape, solidity, finger lengths, palm width, and hand length features for matching, while comparing of SVM and Naive Bayes methods for matching neural networks was done. The multimodal biometrics was proposed for improving the biometric systems accuracy [28].

4. The Proposed Model

The collection comprises of the images of all 50 users, 10 images from each user. They are used for the process of enrolment to describe the user's templates, or feature vectors. The remaining images make up the second image group. In this proposed model, only the hand images of the users are attained. The captured images are stored to keep away from any effects on image parameters such as dimensions changes (pixels), values in texture changes due to different sources, and bmp formats for potential image processing on the computer .
Before extracting features from an image, the input image captured by colored image may be helpful for pre-processing the image to minimize unrelated noise or information. As well as to increase the picture's properties to becoming features more reliable and easier. Due to various factors such as dirt, random noise is generated. There may be particles of dust, etc. In the process of extracting features, it can cause significant degradation, which can result in higher rates of errors in the process of classification. This removal of noise is therefore crucial to the system. These transforms may also cause loss of information from the original image. Therefore, the parameter setting process for applying a specific transformation to the genuine image must be performed carefully. There may be rounds of image processing before the final image is sent for feature extraction. Our research consists of the following blocks:

4.1. Conversion Color Hand Image to Gray and Binary

Web camera output image is a color.jpg image file with a size larger than other image types. Hence it takes more time for the processing of the .jpg along with complication of algorithm. Therefore, color image was transformed into binary image and gray scale because the binary image and gray scale processing algorithms in the actual application are relatively easier to implement. But this conversion has drawback such as loss of image information.

Figure 7. Converting color, gray scale and binary image

4.2. Hand Geometry verification System

In reality a hand geometry verification system is a pattern verification system that can be distributed into two stages, namely verification and enrollment. In the enrollment stage, samples of training are collected and the pre-processing, extraction feature and modeling modules are used to generate the matching templates. In verification stage, a query sample will as well be processed by the pre-processing and feature extraction techniques whether it is a unaffected sample or a counterfeit one.

Usage of simple setup with a web cam, the hand images can be achieved. Other biometric features, however, require a specialist, costly scanner to obtain the data. Biometrics users' acceptability on the basis of geometry of hand is quite higher because the features of users are not detailed.

Hand geometry can be used in the applications which require biometric features to be distinctive enough for verification. It is a fact that the hand of a human after a certain age does not change significantly. But the human hand, like fingerprints, is not unique. Individual hand characteristics alone cannot be used to identify. However, when used in combination with different independent features and hand and fingers measurements of systems of hand biometric recognition become accurate for verification purposes .

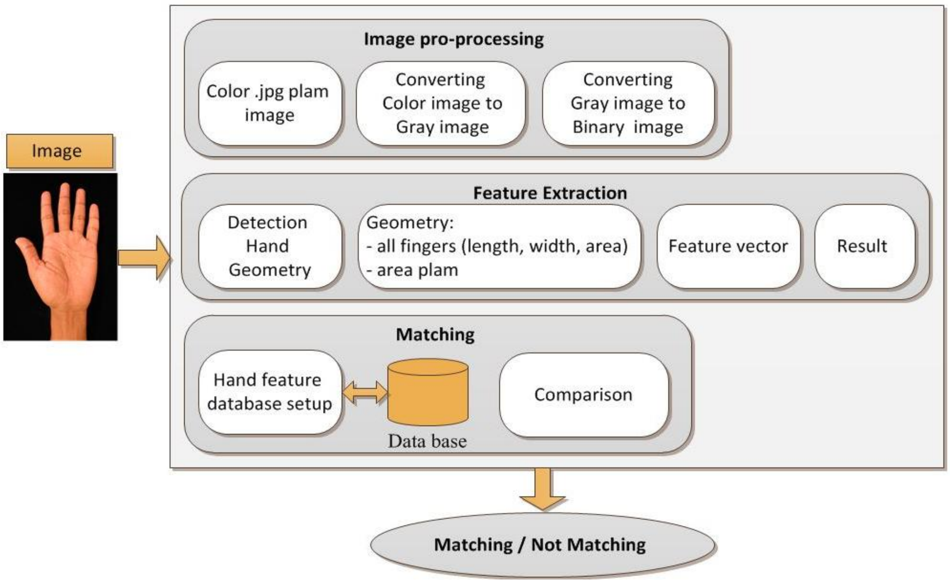


Figure 8. The proposed architecture of multimodal biometric.

Hand biometric verification systems examine and measure the entire hand’s shape, structure, and proportions e.g. hand’s width, length, thickness, and joints and fingers along with certain surface of skin characteristics such as ridges and creases. Some biometrics systems measure nearly 90 parameters with hand geometry. Since hand biometry depends on the geometry of the hand and the finger, usually the process takes just a few seconds. The users place their hand palm on the surface for the reader to enroll.

The benefits of hand biometric systems are given below:Smaller data quantity is needed for identification of a user distinctively, so that numerous templates can be stored autonomously in a stand-alone device: Systems of hand biometric typically require only 10 bytes of template size, which is very small compared to the other technologies of biometric, e.g. 250 to 1,000 bytes and 1,500 to 3,000 bytes of fingerprint systems are required for voice biometric systems.

4.3. Feature Extraction

The succeeding segment of biometrics of geometry of hand is the extraction of features. Extraction of features is a distinctive form of reduction of dimensionality in image processing and pattern verification. If the input data is too large to be processed in an algorithm and it is doubted that it does not contain much information in particular, the input data will then be converted into a smaller set of vector functions. It is called extraction of features to convert the input data into features set. If the extracted features are carefully selected, the set features are believed to extract the appropriate information from the input data to do the required duty while reduced representation usage rather than the complete input. The hand authentication system based on geometry is dependent upon the human hand`s geometric invariants. Usual characteristics include finger length and width, palm or finger aspect ratio, hand thickness, so on. The primary feature that can be extracted is a finger's length while the secondary can be dug out the finger's width. At different points of the finger, more than one measurement can be taken for the width. The length of the lines on the finger can also be used as a measure of the width of the finger. Since the width of the fingers may not be uniform, more than one measurement is usually taken at different points for each finger.

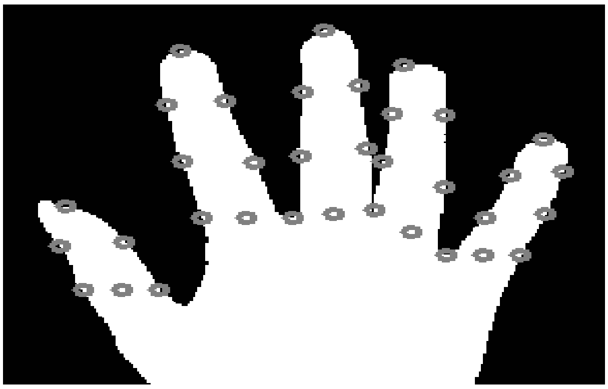


Figure 9. Features extracted from the input image

4.4. Matching

The biometric system's final component matches. The matching feature will determine how similar the stored vector feature and the claimed vector feature are. The features here found in the previous part are compared to that person's features stored in the database. Actually, the appropriate step calculates how similar two hand templates are. Other than that, many systems of hand recognition also include an optional step in the membership database to update the reference template. During the period of some past years, hand recognition is considered more appropriate for verification only, as the hand features for each individual are not one of a kind. As the population sample becomes large, the likelihood increases for two people with similar hand characteristics. So, to decide if the claimer is actually the claimed individual, distance functions are used. The function of absolute distance is used for comparing the vector feature in this suggested system. Equation (1) is Absolute distance is defined by the following formula:

$$D_a = \sum_{i=1}^{d} |y_i - f_i| \tag{1}$$

Where f_i= h (f_1, f_2.. f_d) is the feature vector of a registered user's d dimension in the database, and y_i= h (y_1, y_2.. y_d) is the feature vector of an unknown or a claiming person. Consequently, the distance between the claimant and the register user is the distance between the claimant vector y_i feature and the database vector f_i feature.

4.5. Training the Network – Learning

Back-propagation necessitates training set (output / input pairs). It starts with tiny random weights. Correction of error learning is used to maintain the weights after comparing outputs in supervised learning. Gradient descent can be used to minimalize an error function. Advantages: It works comparatively fast. There are some alternative back-propagation techniques as well. One of them being Hebbian learning is unsuccessful in feed-forward nets while the other reinforcement learning has just a limited success. Furthermore artificial evolution is a more genera technique which is possibly slower .

4.6. Topology

The following steps show how can applying topology:

1. Architecture: multi-layer feed forward back-probagation
2. Number of input neurons : 12 correspond to (12 Length and width characteristics of 5 fingers and palm).
3. Number of hidden neurons in hidden layer: 10 by guesswork.
4. Number of outputs neurons: depends on number of classes (here persons) which are 80.
5. Training method : log-sigmoid, 'logsig' in Matlab
6. Activation function : momentum gradient decent, 'traingdx' in Matlab
7. Error rate measure : sum of squared error, 'sse' in Matlab
8. Stopping criteria : either error reaches 0.001; or maximum training epochs reaches 5000

The Figure (10) show of The Traing Epoch method System performance employing the hand images of hand image database.

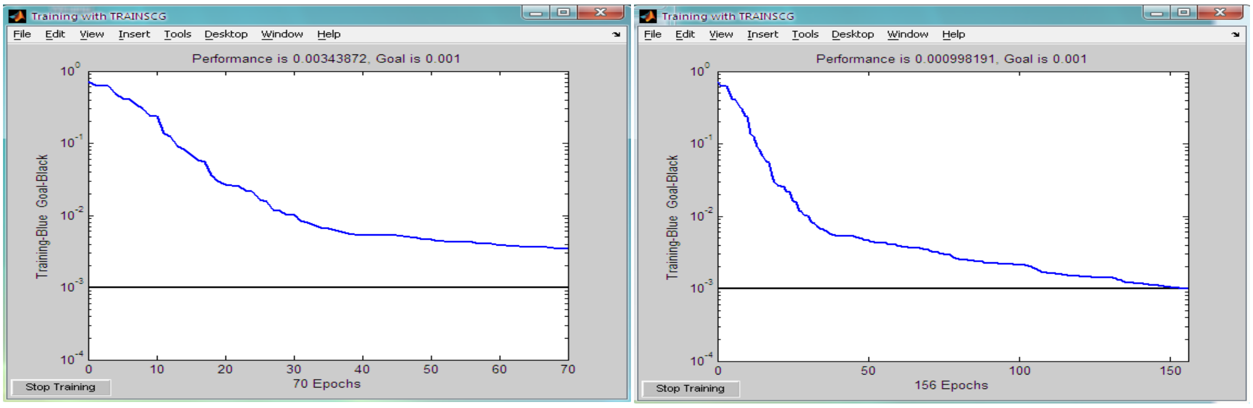


Figure 10. The Traing Epoch method System performance employing the hand images of hand image database

To study system efficiency, for different threshold values, both the false acceptance rate and the false rejection rate are plotted. By comparing vectors of the database feature with the same hand vector, a false acceptance rate is achieved by matching the different hands feature vectors. When a feature vector in the database is compared to those feature vectors representing a different user and after comparing if the match value is less than the selected threshold, it is deliberated to be a false reception by the system. This process is recurring for all the users in the database. On the other hand, when a feature vector in the database compared to those feature vectors that represent a same user and if the match value surpasses the chosen threshold then it is considered to be false rejection.

In this experiment both the value of false acceptance rate and then false rejection rate is calculated at different threshold values. The various values of FAR and FRR at different threshold are given in Table 2.

Table 2. The different threshold value and value FRR and FAR.

No.	Threshold	FRR	FAR
1	0	100	0
2	1.0	65	0
3	2.0	16	2
4	3.0	5	9
5	4.0	2	8
6	5.0	0	40
7	6.0	0	57

5. Experimental results and evaluation

The system emphases on performing feature extractions from a standard database then developing a neural network classifier on the basis of back-propagation architectures with various methods of training. Features are dug out using morphological (segmentation) operation.

Our Experiments were carried out on 500 images (50 persons, 10 images each) under distinctive conditions with possible deliberation of scaling, Translation, Rotation, Color and Illumination modification. The accurate recognition rate is approximately 96.41 % for the matching of artificial neural network, which is calculated by the formula the average of sum of errors divided over the number of images.

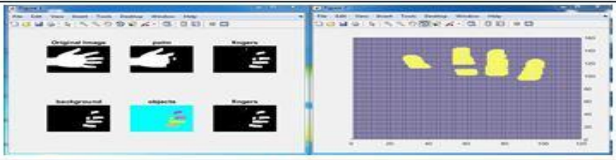
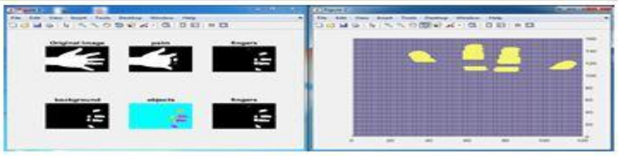
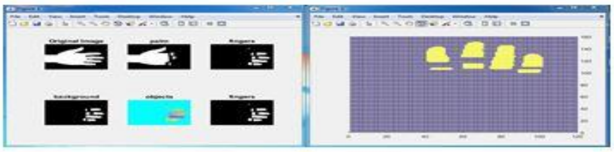
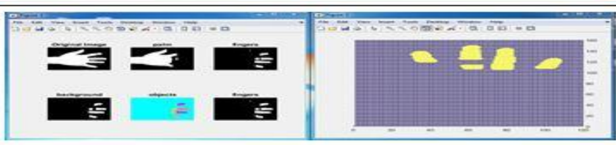
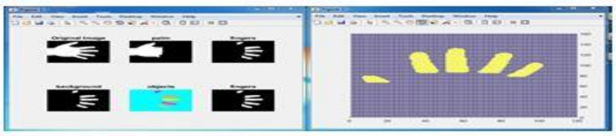
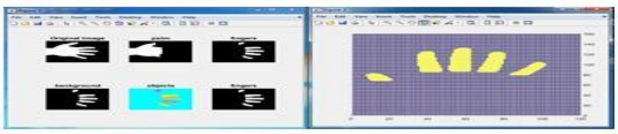
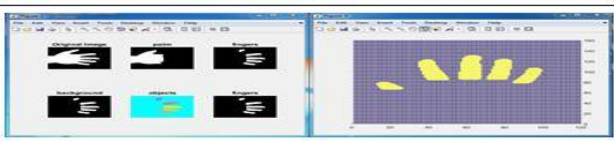
The recommended system of prototype is run in MATLAB language (R2017a), using an i5-processor (2.33 GHz) machine with 4 GB Ram, and Windows 10 as an open source operating system. The following experiments are carried out for better validation of the recommended method .In the work used 500 fingerprint images that are 50 persons times 10 images each. Images are originally in ".JPG" format, we used a tool to resize. Here are images of the first ten person.

Table (3) shows the experimental results. Which were applied to a randomly images selected from database. Where we show how to insert the hand-image to the proposed system, then the process of extract the total palm area, the height of the fingers and the proportion of similarity and error of each image and match with the original picture. shown in Table 4 In the other hand shows a trial-procedure, step by step using the proposed system. It shows how to extract the required parameters and compare the results with the images stored in the database as shown in Table (4).

Table 3. Shows the simulated results of a selected group (which are randomly selected from the database).

Images	Area of palm	Area of fingers			Match with error	Images	Area of palm	Area of fingers			Match with error
		No.	Length	Width				No.	Length	Width	
Image1	363811	finger1	90.7095	18.1115	0.05423	Image6	384105	finger1	92.8273	18.0256	0.00778
		finger2	299.707	97.4773				finger2	114.278	108.525	
		finger3	368.853	100.189				finger3	107.472	85.6408	
		finger4	109.100	86.5364				finger4	183.395	90.6562	
		finger5	111.819	12.7203				finger5	114.315	2.3094	
Image2	363822	finger1	90.9416	18.0774	0.00945	Image7	291148	finger1	136.271	86.4217	0.16584
		finger2	299.663	97.4092				finger2	272.520	82.3815	
		finger3	108.261	91.5919				finger3	375.383	99.2108	
		finger4	109.368	87.4589				finger4	364.557	91.9769	
		finger5	282.559	96.9691				finger5	429.597	100.421	
Image3	370738	finger1	45.2726	3.4790	0.00752	Image8	296082	finger1	138.859	87.5985	0.17671
		finger2	90.4556	14.9606				finger2	267.697	82.2233	
		finger3	111.459	75.0196				finger3	359.087	92.6573	
		finger4	114.315	2.3094				finger4	358.303	98.0189	
		finger5	111.380	70.8569				finger5	418.281	100.920	
Image4	404314	finger1	86.9094	12.5416	0.00812	Image9	291746	finger1	145.054	90.8453	0.23369
		finger2	113.503	74.7735				finger2	263.144	81.1644	
		finger3	111.084	68.1863				finger3	364.452	91.9878	
		finger4	138.754	82.7052				finger4	367.033	97.7334	
		finger5	114.315	2.3094				finger5	425.026	100.208	
Image5	360460	finger1	98.7370	2.3093	0.04390	Image 10	288534	finger1	145.299	89.6543	0.24643
		finger2	91.9169	16.1809				finger2	279.465	83.5986	
		finger3	114.315	9.2376				finger3	362.371	97.7919	
		finger4	113.120	58.6493				finger4	427.049	100.468	
		finger5	112.335	33.5155				finger5	366.645	92.7564	

Table 4. Shows the simulated results step-by-step.

Images		Extract features
Image1		
Image2		
Image3		
Image4		
Image5		
Image6		
Image7		
Image8		
Image9		
Image10		

6. Conclusion and Future Work

The hand-centric image technology is the most widely used in modern biometric systems. Perhaps the most developed and relevant biometric technique is hand recognition biometrics. Hand geometry recognition systems are extensively used for applications in physical access, tracking of attendance, and identity verification. They have found a maintainable market position through utilization in security and accountability applications. What makes them a popular choice for most clients who require verification systems are the facts that they are easy to

use, have stand-alone capabilities, and require a small amount of data. The greatest weaknesses of hand geometry are because of the following reasons. The size of the hand confines the applications of biometric systems. At least two out of a hundred people randomly selected will have similar geometry of their hands.
Any hand injury can possibly have pronounced impact on the recognition system. Since one cannot always attain all the needed information in the acquisition process, measurements have to be done numerous times. This method can easily be falsified if we can find the most suitable hand. We can easily recapitulate that in modern biometric systems, the technology which is based on the hand image is most commonly utilized. The purpose of this work is to develop a system of hand recognition that can be used in multiple applications of security, such as transferring payments to employees through various levels of projects for financial inclusion, border checks at airports and immigration. The suggested system gives 96.41 % accurate results of recognition rate against blur palm images.

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