COMBINATORIAL FEATURE EXTRACTION FOR HAND SURFACE BIOMETRIC SYSTEM

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ABSTRACT

In computer security, current progression in computer technology has improved the utilization of computerized biometric-based recognition and substantiation systems. These systems are considered to notice the uniqueness of an individual when it is anonymous or to confirm the individual's individuality when it is offered. These systems classically hold a series of multipart technologies that process mutually to present the preferred result. In turn, estimating these schemes is also a difficult process. So, a multimodal biometric system is presented in the previous work to extract the features by integrating four different modalities palm-print, Finger print, Hand geometry and Finger Knuckle-Print (FKP). But the obtained features do not provide accurate hand surface biometric system. To enhance more accurate, resilient and robust hand surface biometric recognition system, it is necessary to evolve combinatorial features of hand surface. In this work, we concentrate on deriving combinatorial feature models which generate different combination of dynamic features of the hand surface. The multiple combinatorial features are evaluated for threshold criteria, which suits the accurate combination of most unique features of the hand surface. Experimental evaluation is made with real and synthetic hand set images from research repositories with different positions to examine the performance of the proposed combinatorial feature model for hand surface biometric system in terms of combinatorial feature set size, number of hand images and efficiency.

Keywords: Hand surface, Biometric recognition system, combinatorial feature model, threshold criteria.

1. INTRODUCTION

Recent improvements in computer hardware and software have allowed industry to expand reasonable computerized biometrics-based recognition and substantiation systems. These systems are currently utilized in a broad choice of environments, for instance social welfare, law enforcement, banking, and a mixture of security applications. Many biometrics, as well as facial features, fingerprints, retina, iris, hand geometry, handwriting, and voice, have been utilized for the recognition and substantiation of persons. Each biometric has its individual merits and demerits, and selecting the finest one for a precise application is prejudiced by both performance principle and operating setting. When scheming a biometrics-based system, it is very significant to identify how to determine the precision of a system. The accuracy is dangerous for shaping whether the method meets

necessities and, in practice, how the classification will react. Measuring the correctness of this coordination is a main deliberation and is required for the objective collection of such systems.

In common, diverse computerized biometrics-based recognition and substantiation systems have a variety of parameters that can be attuned to develop performance. These bounds might contain diverse values for diverse application environments. The merits of the developers of the mechanized biometrics-based recognition and substantiation systems are learned concerning the excellence and individuality of the biometrics utilized by their systems as well as how they involve the presentation of their systems. Such information permits the developers to fine adjust the method to optimize performance. As a result, a minute model is offered to the composed data as improvement data setto developers for their information. We stay away from the system's being qualified to a distinct data set by testing with the balancing position of composed data. The complete composed biometric data set consequently is divided into two major groups:

- The expansion data and
- The test data

With to the remarkable progress in information technology, the exploration is on for more vigorous and consistent substantiation techniques for a broad range of applications. Biometrics has appeared as potentially giving out a resolution to cope with this type of crisis, since biometric data cannot be simply stolen or shared. As a result, they have been utilized effectively in a broad mixture of applications. Nevertheless, biometric schemes are distant from ideal. For instance, in the box of hand surface substantiation, it is recognized that a little portion of the population might be unsuitable for the automatic classification as of inherited factors, or period, or for professional reasons. Biometric detection imposes numerous limitations on how the facial images are attained, fairly often entailing a permanent background and proscribed clarification. Signature appreciation needs call with the writing tool and effort on the part of the user. In synopsis, every biometric scheme has its boundaries.

To defeat the constraints compulsory by a distinct biometric system, numerous researchers have examined the utilization of numerous sensors to detain diverse biometric traits. This area of research is termed as multimodal biometrics. The synthesis of the different traits can be attained at the feature pulling out, matching score, or conclusion level. Combination at matching score stage has the benefit of utilizing as much information as probable from each biometric modality, as at the equivalent time allowing the addition of off-the-shelf biometric schemes. It is appeal noting that a normalization pace is usually essential before merging scores from diverse matchers.

There are three kinds of multimodal biometric system.

- The first kind is termed as transformation-based.

  Here the matching scores are regularized to leave them on a similar scale. There are numerous techniques to realize the fusion of diverse matchers, for instance sum, max, weighted sum, etc. In addition selecting the finest fusion approach, the utilization of weights to point out the significance of the matching scores offered by each biometric attribute should also be measured.

- The second kind of fusion is termed as density-based,

  It relies on the estimation of the joint attention of the identical scores, and the fusion is established out by arithmetic tests, for instance the possibility ratio test. This kind of fusion system attains good presentation if the concentrations on image can be well educated, specified that a huge number of delegate training matching scores are accessible.

- The third strategy is classifier based.

With this approach, the scores formed by every biometric system are measured as features to provide for a classifier. In such a type, every input prototype should be tagged as either authentic or a plant.

Even though these types of classifier system are presented, the process of biometric system is not well worked. So, in this work, we are going to evaluate the process of hand based biometric system based on combinatorial feature extraction model.

2. LITERATURE REVIEW

Hand based biometric systems; mainly hand/finger geometry based support systems are along with the greatest in terms of user correctness for biometric traits. This is apparent from their widespread beneficial deployments regarding the world. Regardless of the viable success, quite a lot of crises stay after to be addressed so as to manufacture these systems more accessible.

The paper [1] addressed the crisis of dispersed coding of images whose connection is motivated by the activity of objects or positioning of the visualization sensors. It relies on the crisis where images are programmed with compacted linear dimensions. We present a geometry-based relationship representation so as to depict the widespread information in images. Proposal of algorithms that are capable to guess video eminence as supposed by individual observers is of attention for a number of applications. Based on the video contented, the artifacts presented by the coding procedure can be new or less prominent and diversely provides the class of videos, as anticipated by humans. In [2], the result of scheming numerous point measure features, communicated to video coding artifacts, disjointedly for prominent activity and other regions of the frames of the succession is analyzed.

In [3], the author discussed the crisis of localization and appreciation of human actions in unsegmented image series. The major involvement of the proposed technique is the utilization of an hidden illustration of the spatiotemporal outline of the motion which provides on the spatiotemporal localization of quality consists of feature descriptors. The paper [4] presented the novel color face detection (FR) technique that makes efficient use of learning as color-component attribute collection outline. The proposed boosting color-component quality collection structure is planned for identifying the finest position of color-component skin texture from different color spaces (or models), aiming to accomplish the preeminent FR presentation for a specified FR task.

Palmprint is a capable biometric characteristic for utilization in access control and forensic requests. Earlier research on palmprint identification chiefly a novel recognition algorithm for high-resolution palmprint [5]. The major assistance of the proposed algorithm comprises of the subsequent things: 1) utilization of numerous features, specifically, finer points, density, direction, and primary lines, for palmprint appreciation to considerably progress the matching presentation of the predictable algorithm. The hand-geometry-based appreciation techniques proposed in the prose have not thus far subjugated user-specific purposes in the feature-level illustration [6].

The paper [7] presented two novel techniques to progress the presentation of palm-vein-based recognition techniques provided in the literature. The novel technique accommodates the possible deformations, revolving and translational variations by programming the direction providing features and providing a narrative region-based matching system.

Normally, biometric system has been energetically mounting in varied industries for the standard little years, and it is continuing to revolve to current senior safety features for access managing system [8]. Several changes of unimodal biometric schemes have been developed. On the other hand, these techniques are only adept to current low to inner point diversity of security feature. Unimodal biometric systems perform person recognition supported with a different source of biometric in series.

Some of the scrapse that occupy unimodal biometric systems can be enhanced by employing multimodal biometric systems. Hand-based person appreciation provides a reliable, low-cost and user-friendly practicable solution for a diversity of access control appliances [9].

A plain palmprint biometric system attaining the palmprint, a characteristic extracting the module, for palmprint representation, and a equivalent element for decision making [10]. A principle palmprint admiration scheme should be processed on the combination of numerous palmprint processes [12]. Actually, in differentiate to other modules like face and iris; the human hand contained a extensive variety of modalities, which are fingerprint, hand geometry, palmprint and Finger-Knuckle-Print (FKP) [11]. But this extensive choice of modalities does not develop the biometric systems fine.

These issues motivated us to develop the combinatorial feature model to enhance the hand based biometric scheme for user authentication.

3. PROPOSED METHODOLOGY

The proposed work is efficiently designed for enhancing the hand based biometric system by adapting the combinatorial feature model. The combinatorial feature model is constructed based on combining the dynamic features of the hand surface. The hand surface system includes hand based geometric system, palm-print and the finger knuckle feature vectors. The architecture diagram of the proposed combinatorial feature model for hand based biometric system is shown in fig 3.1.

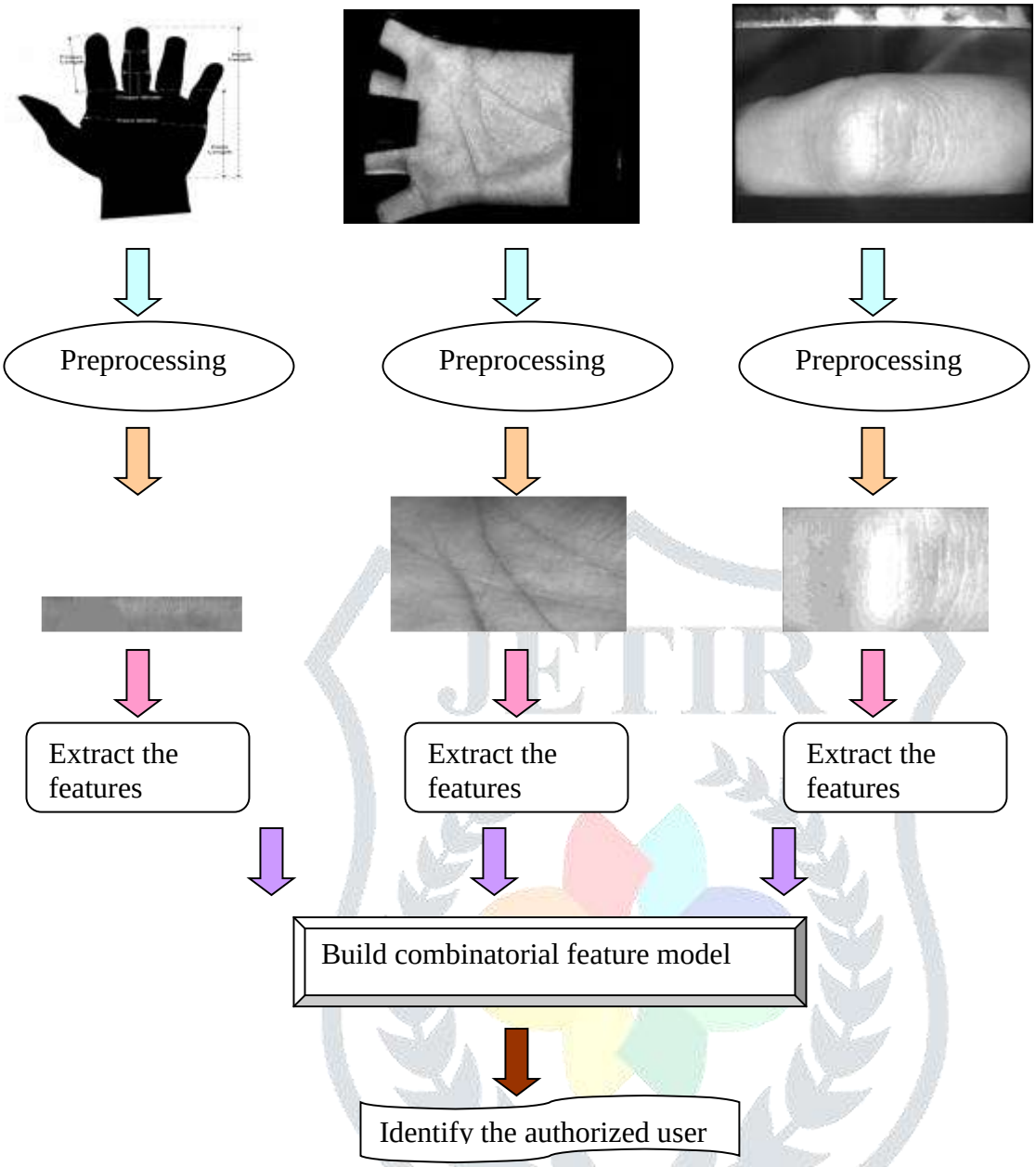

Fig 3.1 Architecture diagram of the CFMHBS

Fig. 3.1 shows the block diagram of the proposed combinatorial feature model for hand based biometric recognition system. The primary step is to apply preprocessing to take out the region of interest from every biometric hand image which acts as an input. Then the feature vectors are hauled out from every obtained biometric individually. With the obtained features from the hand image, the combinatorial feature model is built efficiently to combine all the dynamic features of the hand surface. Based on this unique combinatorial feature, it is easy to identify whether the user is authorized or unauthorized.

3.1. Image preprocessing

In this stage, the input hand image is preprocessed with the purpose of regulate the disparity and intensity of input image. Then, middle filter is exercised to eliminate the “Salt and Pepper” form noises from the preprocessed image. It decreases the shadowing of edges. Further, some unnecessary segments of the unusual images were yielded mechanically, ensuing in obvious hand images of consistent size. The images were then leveled down to an appropriate size, lesser than the unique size for managing them with improved performance in terms of speed.

3.2. Finger knuckle print identification system

The convention of Finger knuckle images for personal classification has revealed promising outcomes and engendered a lot of interest in biometrics. Finger knuckles of the human hand are typified by the folds on them. These creases vary from person to person. In the FKP classification system, after gathering the FKP images then relate preprocessing methods on all the preparation images then take out the feature from the finger images.

Here, Ridgelet transform is utilized to haul out the important knuckle print features. The process works particularly on hand images with lines. As knuckle print is generally made up of parallel like ridge lines, Ridgelet technique would be capable to manage the line pattern more efficiently. Discrete Ridgelet transform can also manage the line singularity efficiently during Radon transform, and then utilizing Wavelet transform on every projection lines present in the Radon transform domain. The design following the Ridgelet transform was to plan a line singularity to a tip singularity by utilizing Radon transform and then Wavelet transform is presented to symbolize the point singularity in the Radon transform. Ridgelet transform symbolizes the presence of straight edges in images employing little coefficients where the considerable coefficient illustrates the guidelines of the image lines with the uppermost energy.

Ridgelet transform is termed as the summing up of image pixel values with a set of lines present in the knuckle prints. Consider $W_p = \{0,1,..., p-1\}$ where p is a prime number, the ridge let transform of a actual utility, f (m, n), on the finite pattern lines of the knuckle finger print W_P^2 is defined as,

$$RT[a,b] = \frac{1}{\sqrt{p}} \sum_{(m,n)\in L_{a,b}} f(m,n)$$

Where $L_{a,b}$ indicates a collection of points that shape a line on the pattern,, a determines the gradient of the line, and *m* denotes to the coefficients of Ridge let transform in all direction represents the lines present in the knuckle fingerprint. These lines are specified as,

$$L_{a,b} = \{(a,b) : b = ax + b(\text{mod } p)\}$$

The knuckle print recognition scheme is attained by captivating the discrete Wavelet transform of every knuckle projection, termed as:

$$FRIT[a,b] = \langle FRAT[a,b], \omega_a^b[b] \rangle$$

Where ω_a^b is the Wavelet basis utility of FRAT

The knuckle print recognition scheme can be utilized to represent knuckle prints which include ridge-like prototypes. A block-processing scheme is presented to manage the knuckle print images of diverse sizes. Every knuckle print image is divided into *N* blocks and knuckle print recognition scheme is achieved nearby on every block. The ridgelet coefficient is then planned to attain its energy level, *E*. Given the ridgelet coefficient as R_1, R_2,..,R_j the e is calculated as,

$$E = \frac{1}{R_i} \sum_{i=1}^{n} | R_{i,n} |$$

The above equation determines the allocation of the ridgelet coefficients, and normalizes the values independent of sub-block size. The obtained energy measures are the features of the knuckle print.

3.3. Palm print Identification system

Palm-print based personal substantiation has rapidly come in the biometric family owing to it's alleviate of attainment, high user reception and dependability. Palm-print not only has the distinctive information accessible as on the fingerprint but has far more quantity of details in terms of principal lines, wrinkles and folds. Each of these features is used to strain I ' (x, y) as follows:

$$I_1(x,y) = h_1 * I'(x,y) \quad \text{..... eqn 1}$$

Where '*' indicates the distinct 2D complication. Thus four filtered images, *i.e.*, $I_1(x,y), I_2(x,y), I_3(x,y)$ are used to produce a final image

$$I_f(x,y) \text{ by } I_f(x,y) = \max \{ I_1(x,y), I_2(x,y), I_3(x,y) \} \text{..... eqn 2}$$

Even though the lines on palm and knuckle prints are similar, we cannot employ the same procedures process because the knuckle print has simpler and horizontal-like line patterns. In the meantime, for knuckle print recognition scheme, ridgelet transform would be more appropriate. With this, palm print has some crossed line patterns from diverse directions and therefore some other solution is required to attain the palm print features.

Primarily, Wavelet Transform is used to divide the palm print images into minor decision illustration. Subsequently, 2D Gabor filter is used on the extracted images for palm print depiction. Figure 3.2 depicts the extraction of the features of the palmprint with this approach. In this research, combinatorial feature model is deployed as the feature matching tool.

Fig 3.2 palm print textures obtained from 2D Gabor filter

3.4. Combinatorial feature model scheme

In this paper, several feature model schemes are utilized to unite the palm print and knuckle print features. Exclusively, the combinatorial feature model has experienced the technique with AND- and OR-voting rules, summation rule, in addition to weighted sum rule. The combinatorial feature model is the simplest combination technique for adapting the enhancement of human biometric system. With the combinatorial feature model, the obtained features of the finger and knuckle print using appropriate method is properly defined and processed. On the other hand, combinatorial feature model takes the average of the matching scores obtained after the feature extraction process. The summation of both matching score is determined as

$$CF = ms(P) + ms(K)$$

Where ms (p and k) symbolize the matching score of palm print and knuckle print correspondingly with the output class with the smallest value of *S*. The major benefit of this combinatorial feature model is its simplicity, and the truth that it does not require any training set of images.

4. EXPERIMENTAL EVALUATION

An experimental evaluation is conducted to estimate the performance of the proposed combinatorial feature model for hand surface verification systems. The proposed combinatorial feature model is implemented in MATLAB. Finally experimental evaluation is made with real set of hand images and also synthetic hand image from research repositories with different positions to examine the performance of the proposed combinatorial feature model for hand surface biometric system and compared with existing works. At first, various features of the hand surface such as palm print, finger print, finger knuckles and hand geometry are extracted from the hand surface with different positions. Each feature is initially extracted with geometric dimensions such as size, length, height, and depth of the hand surface. Then the features are extarcted from the appropriate hand images and combined all the dynamic features using combinatorial feature model. The performance of the proposed combinatorial feature model for hand surface biometric systems is evaluated in terms of

i) Combinatorial feature set size,

ii) Security level

iii) Time consumption

iv) Efficiency

5. RESULTS AND DISCUSSION

In this work, we have seen that the proposed combinatorial feature model is efficiently desgined for hand surface verification systems. For a diverse set of hand images, the features are extracted at first by following the set of processes like Image preparation, Image preprocessing, Segmentation, Hand geometrical feature extraction, Knuckle print extraction, and combinatorial model. After extracting all set of features, the geometric dimensions such as size, length, height, and depth of the hand surface are also been extracted to get the ridges and turfs of the palm, finger and knuckle prints. The below table and graph describes the performance of the proposed combinatorial feature model for hand surface verification systems.

Combinatorial feature set	Security level (%)		
	Proposed CFMHBS	Existing MBHRP	Existing palm vein images
10	75	50	32
20	79	53	35
30	84	56	38
40	86	59	41
50	89	63	45
60	92	65	47

Table 5.1 combinatorial feature set size vs. security level

The security level of the biometric systems is analyzed based on the combinatorial feature set. The proposed combinatorial feature model for hand based biometric recognition system is compared with the existing Multifeature-Based High-Resolution Palmprint Recognition [5], Human Identification Using Palm-Vein Images [7].

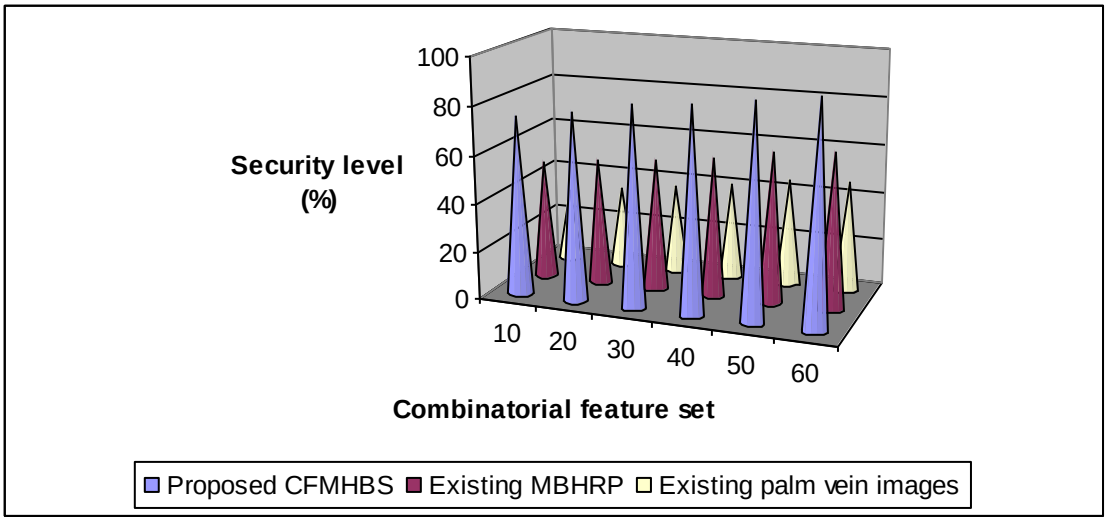

Fig 5.1 combinatorial feature set size vs. security level

Fig 5.1 describes the security level of the biometric systems is analyzed based on the combinatorial feature set. The security level is measured based on the rate in which how secure the user authentication is done effectively with the appropriate process. Compared to the existing works like Multifeature-Based High-Resolution Palmprint Recognition, Human Identification Using Palm-Vein Images, the proposed CFMHBS provides high level of security. Because both the existing works mainly concentrates on low resolution hand images and does not support high level security applications. But in the proposed CFMHBS, it supports both the high and low resolution hand images to enhance the high level security applications. So, the variance in the security level is 30-40% high in the proposed CFMHBS.

Combinatorial feature set	Time consumption (sec)		
	Proposed CFMHBS	Existing MBHRP	Existing palm vein images
10	5	12	15
20	11	18	21
30	14	24	25
40	17	29	32
50	19	35	37
60	21	40	45

Table 5.2 combinatorial feature set size vs. time consumption

The time consumption of the biometric systems is analyzed based on the combinatorial feature set. The proposed combinatorial feature model for hand based biometric recognition system is compared with the existing Multifeature-Based High-Resolution Palmprint Recognition [5], Human Identification Using Palm-Vein Images [7].

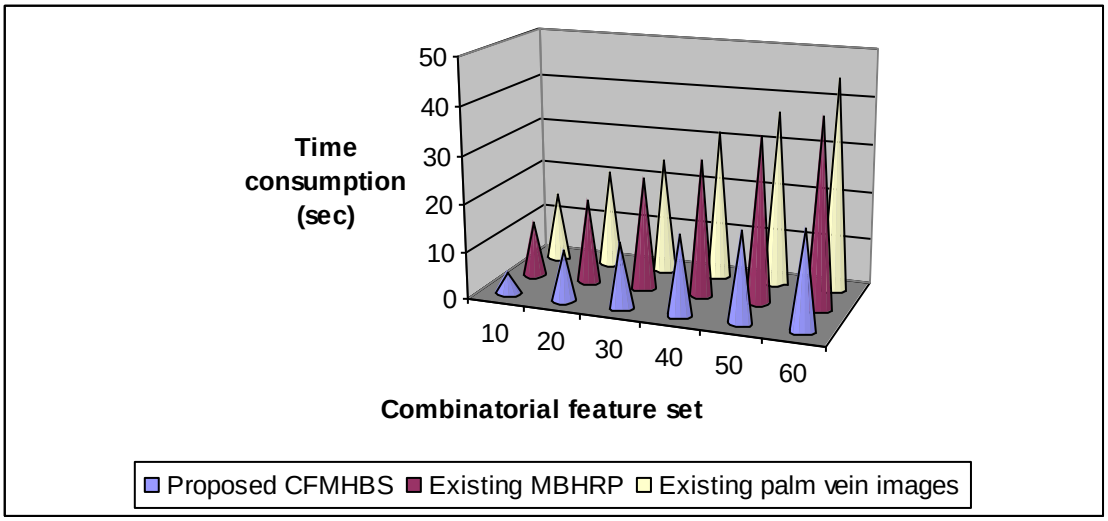

Fig 5.2 combinatorial feature set size vs. time consumption

Fig 5.2 describes the time consumption of the biometric systems is analyzed based on the combinatorial feature set. The time consumption is measured in terms of second who describes time on which how secure the user authentication is done effectively with the obtained set of features. Compared to the existing works like Multifeature-Based High-Resolution Palmprint Recognition, Human Identification Using Palm-Vein Images, the proposed consumes less amount of time to process the feature images. Because both the existing works mainly processes the hand images individually, this consumes more time to access.

Number of hand images	Efficiency (%)		
	Proposed CFMHBS	Existing MBHRP	Existing palm vein images
2	80	54	25
4	83	56	32
6	86	59	38
8	89	62	42
10	93	65	46
12	97	69	52

Table 5.3 number of hand images vs. Efficiency

The efficiency of the biometric systems is analyzed based on the number of hand images given as input. The proposed combinatorial feature model for hand based biometric recognition system is compared with the existing Multifeature-Based High-Resolution Palmprint Recognition [5], Human Identification Using Palm-Vein Images [7].

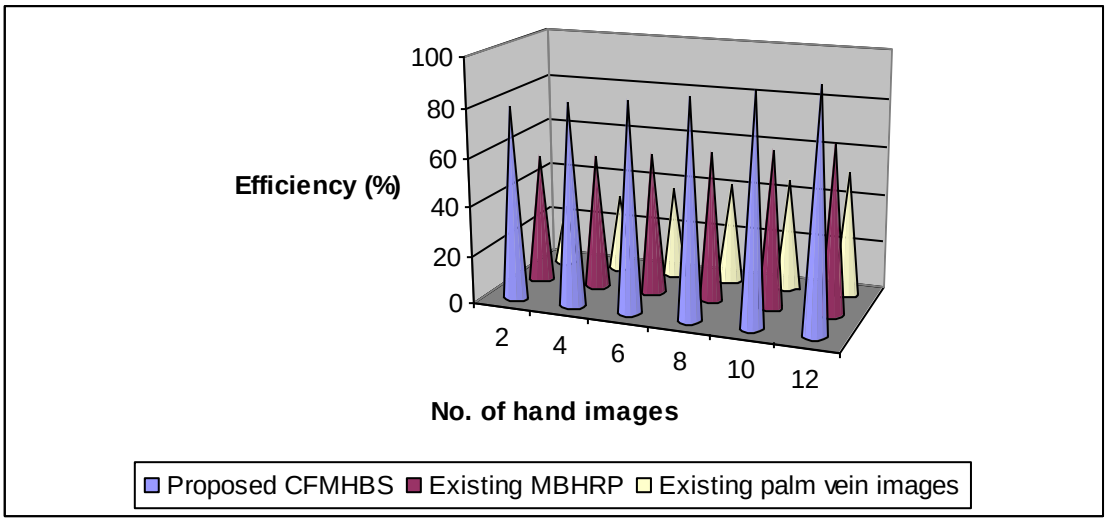

Fig 5.3 number of hand images vs. efficiency

Fig 5.3 describes the efficiency of the biometric systems is analyzed based on the number of hand images given as input. The efficiency is measured in terms of rate at which how the user authentication is done accurately with the appropriate procedures. Compared to the existing works like Multifeature-Based High-Resolution Palmprint Recognition, Human Identification Using Palm-Vein Images, the proposed CFMHBS has high level of accuracy to process the given hand images. Because both the existing works mainly consumes more time and provides less security. But the proposed CFMHBS used multiple set of features for hand based biometric recognition system to considerably enhances the accuracy of user authentication scheme So, the variance in the accuracy is 35-45% high in the proposed CFMHBS.

Finally, it is being observed that the proposed CFMHBS is mainly designed for enhancing the hand based biometric systems by extracting the multiple set of features from palm print and knuckle print images. This combinatorial feature model handles the hand based biometric scheme with large amount of feature set, leading to much high accuracy compared to the existing works.

6. CONCLUSION

In this paper, a combinatorial feature model is presented for hand based biometric recognition system using three modalities including hand geometry, Palm-print and Finger-Knuckle with fusion at combinatorial level is proposed. The process of diverse fusion techniques on the identification presentation of our combinatorial based feature model for hand based biometric system is efficiently studied. We showed that the proposed CFMHBS system also shows an admirable biometric recognition presentation. This work can be used in the expansion of multimodal biometric system for hand based biometric system that can include multiple fusion schemes in a active construction to ensure unreliable security levels based on extracting the dynamic features of the hand, Experimental evaluation showed that the proposed CFMHBS provides resilient and robust biometric system and achieves high security compared to the existing works.

REFERENCES

[1] R.Sumangali et.Al,"Multi - Modal Feature Extraction Scheme for Hand Surface Verification Systems" International Archive of Applied Sciences and Technology, Vol. 4 Issue2, Pages 46-55,Society of Education, India, 2013.

[2] Vijayaraghavan Thirumalai and Pascal Frossard , "Distributed Representation of Geometrically Correlated Images with Compressed Linear Measurements", IEEE Transaction on Image Processing 2012

[3] DubravkoC´ ulibrk ET. AL., "Salient Motion Features for Video Quality Assessment", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 20, NO. 4, APRIL 2011

[4] Antonios Oikonomopoulos et. Al., "Spatiotemporal Localization and Categorization of Human Actions in Unsegmented Image Sequences", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 20, NO. 4, APRIL 2011

[5] Jae Young Choi et. A., "Boosting Color Feature Selection for Color Face Recognition", IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 20, NO. 5, MAY 2011

[6] Jifeng Dai et. Al., "Multifeature-Based High-Resolution Palmprint Recognition ", IEEE Transactions on Pattern Analysis and Machine Intelligence, (Volume:33 , Issue: 5),

[7] Kumar, A et. Al., "Hand-Geometry Recognition Using Entropy-Based Discretization", IEEE Transactions on Information Forensics and Security, (Volume:2 , Issue: 2)

[8] Yingbo Zhou et. Al., "Human Identification Using Palm-Vein Images", IEEE Transactions on Information Forensics and Security, (Volume:6 , Issue: 4).

[9] A. Meraoumia, S. Chitroub and A. Bouridane, "Person's Recognition Using Palmprint Based on 2D Gabor Filter Response", J. Blanc-Talon et al. (Eds.): ACIVS 2009, LNCS 5807, pp. 720-731, Springer-Verlag Berlin Heidelberg 2009.

[10] Abdallah Meraoumia1 et. Al., "Fusion of Finger-Knuckle-Print and Palmprint for an Efficient Multi-biometric System of Person Recognition", IEEE International Conference on Communications (ICC), 2011

[11] A. Meraoumia, S. Chitroub and A. Bouridane, "Efficient Person Identification by fusion of multiple Palmprint representations", A. Elmoataz et al. (Eds.): ICISP 2010, LNCS 6134, pp. 182-191, Springer-Verlag Berlin Heidelberg 2010.

[12] C. Methani and A. M. Namboodiri, "Pose invariant palmprint recognition," in *Proc. ICB*, Jun. 2009, pp. 577–586.

[13] Rui Zhao, Kunlun Li , Ming Liu, Xue Sun, "A Novel Approach of Personal Identification Based on Single Knuckleprint Image", Asia-Pacific Conference on Information Processing, APCIP, 2009.