Efficient Image Retrieval Techniques for Multi Biometric Images to Improve Biometric Authentication

D. Binu , M. Vignesh

***Abstract**: Multi model biometrics security is focused on recognizing human depends on non identical physical and behavioral features. In physical, recognition of the human features like iris, face, finger-prints and palm print are normally used to improve the security and proper authentication. Recent days, biometrics based identification is used in home automation, bank locker system; attendance maintenance system, crime branch etc.. to identify the human for providing secured services. The proposed multi model biometrics system recognizes the human based on physical traits like iris, finger- print, faces and palm- print to obtain better retrieval accuracy, precision and retrieval speed and reduced error rate, retrieval time and computation time.*

Keywords: Biometric security, Indexing Level Fusion, Performance measures, Computation time, Multi-Model Retrieval

I. INTRODUCTION

To deal with the problem of secure biometric image retrieval and recognition the proposed work contributes the following methods: 1. An iris image retrieval based on SURF indexing technique [1] [2]. 2. An improved LSH indexing technique for finger print image retrieval [1] [2][3]. 3. A weight based sparse coded indexing in facial based retrieval [1]. 4. An indexing method for Palm print based retrieval [1]. 5. Multi model based biometric retrieval and recognition by fusing different uni-model indexing schemes [9] [10].

II. UNI-MODEL IMAGE RETRIEVAL TECHNIQUES

A. An Iris Based Retrieval Using SURF Approach

SIFT (Scale based invariant feature transform) method used two iris based indexing method. First one analyze an iris code obtained from different iris images[1][2]. This code in the form of binary, with its dimension related to the structure of the iris. These codes are initially represented in lower dimensions [8]. After that k-means based clustering method partition the less dimension iris code into several related groups. Next method extract the texture of the iris image by Signed based Pixel Level of the Difference Histogram (SPLDH). This approach did not provide required accuracy and precision. In that method, the color of an iris was used to provide index number and the texture content was used to retrieve an iris images based on the indexing of iris images from DRIVE retina database. Calculated index by using the color of iris, remove the images which were not identical to the query image in iris color. The texture based features of an iris were obtained through SIFT method. However SIFT is expensive for calculation of identification due to higher dimensional descriptor. To solve this issue, SURF based feature extraction algorithm has been used. This is a rotation based invariant interest point detector and descriptor based algorithm. In this the calculated feature points have been removed from the images. It has been found that the images with view change, change in illumination, change in scale and occlusion images. Because of this feature extraction which is used in robot navigation and object recognition. This method retrieved the best matched images compared with our input query image by using two-dimensional information, computed under color space by the blue and red indices of iris images.

$$Y(x,y) = 16 + \frac{1}{256}\left(\begin{matrix}65.7R(x,y) + 129.0G \\ (x,y) + 25.0B(x,y)\end{matrix}\right) \quad (1)$$

$$C_b(x,y) = 128 + \frac{1}{256}\left(\begin{matrix}-37.9R(x,y) - 74.4G \\ (x,y) + 112.4B(x,y)\end{matrix}\right) \quad (2)$$

$$C_r(x,y) = 128 + \frac{1}{256}\left(\begin{matrix}112.4R(x,y) - 94.1G \\ (x,y) + 182.2B(x,y)\end{matrix}\right) \quad (3)$$

In equations (1)(2) and (3), $R(x,y)$, $G(x,y)$ and $B(x,y)$ are red, green and blue respectively for pixel values of (x,y) in the RGB color space. The performance measures are calculated by the different parameters like Retrieval Accuracy, Penetration Rate (PR) versus Correct Rate (CR), False Acceptance Ratio versus False Rejection Ratio, Precision, Computation Time (msec), Correct Index Power (CIP), Recall, Retrieval Time in (seconds), Speedup time as well as accuracy and F-Measure.

B. An Improved LSH Indexing Technique For Finger Print Image Retrieval

An approach for a finger-print based indexing techniques which retrieved the topmost feasible matching features from a large FVC2000 finger print database. This method used the structure for minutia and stability based triangular.

Revised Manuscript Received on January 24, 2020.

* Correspondence Author
Dr. D. Binu*, Assistant Professor(Selection Grade), Sri Ramakrishna Institute of Technology, Coimbatore, India ; binu.ecce@srit.org
Mr. M.Vignesh, Assistant Professor, Sri Ramakrishna Institute of Technology, Coimbatore ; vignesh.ecce@srit.org

An index is assigned for the fingerprint, the vale depends on the extracted features from the finger-print and the calculated index value is used to match a query image [5]. The limitation is it is not sensitive to distorted fingerprint[1][2][3]. LSH (Locality-Sensitive Hashing) based indexing identified the location of the finger print points which is closer to identify the perfect match [4]. But in this method too, the estimation time is high. To reduce the estimation time further, the modification of the Locality-Sensitive Hashing (LSH) algorithm has been applied for finger print retrieval. This algorithm modified the conventional hash value by distributing the data, by uniform hashing, which lead to better retrieval. A hash family function is represented as $h_{a,b}(\vec{v})$ and $H = \{i_1, i_2, \dots, i_n\} \subseteq \{1,2,\dots,n\}$. This technique reduces the computational time and Retrieval Time and improves the Retrieval Accuracy, False Acceptance Ratio versus False Rejection Ratio, Precision, Correct Index Power (CIP), Recall, Speedup time as well as accuracy and F-Measure.

C. A Weight Based Sparse Coded Indexing In Facial Based Retrieval

Mostly two methods of indexing technique is used in real time applications, which normally use large number of data.. They are inverted indexing or hash-based indexing along with bag-of-word model and SIFT based features to obtain more efficient equality findings. Even though , the above two techniques obtained better precision value, they failed to attain high recall value because of large semantic gap. Enhanced Attribute based Sparse Coding method considered human features in the form of representation of sparse. Initially, it used dictionary selection method to analyze the images with different attribute features to form different codes. After encoding the human features into the sparse based representation, it faced error detection problem [7]. In order to calculate the weight of the attributes bat algorithm was used, in which human attributes are identified automatically which provided some mismatched results. To overcome the drawback the combined ASC based improved indexing has been used[1].The Sparse coding is based on the (4) and (5).

$$z_j^i = \begin{cases} \infty, if & j \geq \left[\frac{K}{2}\right] and f_a(i) \geq 0 \\ & j < \left[\frac{K}{2}\right] and f_a(i) < 0 \\ 1, & else \end{cases} \tag{4}$$

$$\min_V \sum_{i=1}^{n} \| - Dv^i\|_2^2 + \lambda \|z^i \circ v^i\|_1 \tag{5}$$

The attribute scores are calculated based on the distance of the image and the weights for dictionary centroids. The weights were calculated based on attribute scores, the images with equal attribute scores with equal weight have a higher chance to equal form of sparse representations. Bat algorithm based weighted ASC words along with improved indexing provided optimized values in all the performance measures.

D. An Indexing Method For Palm Print Based Retrieval

Alternate indexing in biometric based on the scores produced by the matcher algorithm [6]. This matched indexing algorithm utilized very few reference images. For example, the match score is calculated based on matching of all images in the database with a query image, which provided set of match scores. For calculating correlation coefficient by using (6) matched indexing technique, the performance is based on the size of match score vectors.

$$S((C_i \cup C_j), C_k) = \min\left(S(C_i, C_k), S(C_j, C_k)\right) \tag{6}$$

If the match score vectors are very large, then computation time and retrieval time high. Hierarchical Clustering (HC) method used matching stage which rejected most of the palm print images which does not comes under query palm print, thus retrieval time reduced. But false acceptance rate has been increased. The proposed HC-ILSH technique not only save time in terms of retrieval and computation but also increases the p for computing correlation coefficient precision and recall.

III. MULTI MODEL BIOMETRIC IMAGE RETRIEVAL

Existing multi feature fusion technique used 2m-SVM match score fusion algorithm[1]. This identified the matched images from the list of matched images. Another existing fusion method is indexed code fusion, which was performed by concatenation of index codes. However these techniques are not optimal[1][2]. In proposed fusion method all the mentioned indexed codes are fused by combining candidate lists techniques as in (7).

$$Fused_{CV} = [i_{c1}, i_{c2}, \dots, i_{cn} f_{c1}, f_{c2}, \dots, f_{cn}] \tag{7}$$

The fusion of multiple biometric features is done using different approaches. They are score level fusion, Feature level fusion and Indexing based fusion. Among the three methods indexing level fusion provided multiple matchers for providing the index code which is easy to implement and it is compatible with different biometric databases. Figure 3.1 represents the fusion of different biometrics using different indexing techniques. Initially, Iris and Finger print features are fused. Then face and palm print features are fused. Finally the two index codes are fused with different fusion strategies. Among the three indexing methods, indexing level fusion provided better performance compared with score level and feature level fusion.

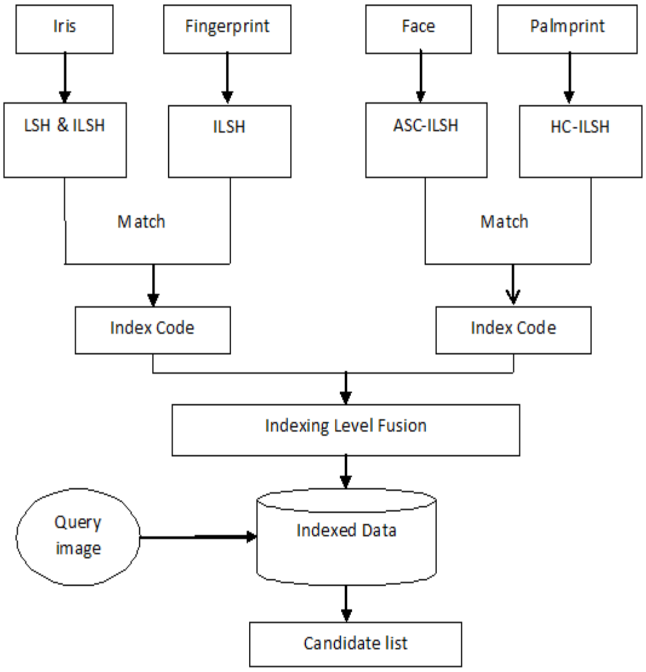

Fig. 1. Block Diagram of Multi Modal Image Retrieval

IV. RESULT AND DISCUSSION

This chapter compares the results of the proposed techniques with existing method in all the uni model and multimodal biometric systems.

A. Iris Image Retrieval

The results were obtained using DRIVE retina database. In which, 1100 iris images were collected and separated into the training and testing data sets in the ratio of 60:40.

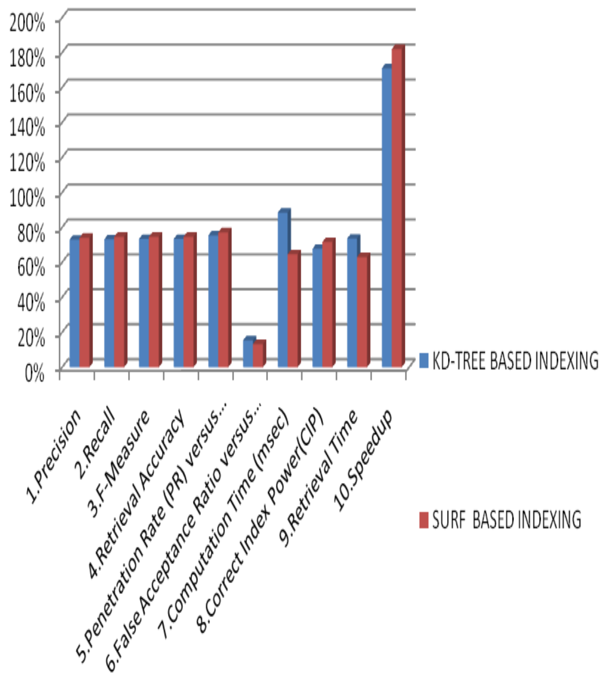

Fig. 2. Iris image retrieval

B. Finger Print Image Retrieval

The simulation was conducted using FVC2000 fingerprint database. From FVC2000 database, for 120 fingers 12 images per finger totally 1440 images were collected. Testing was done using the images collected from 30 volunteers.

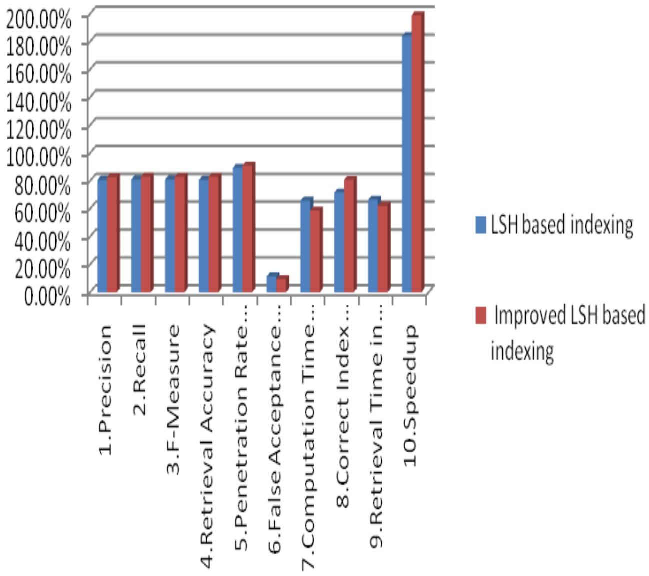

Fig. 3. Finger print image retrieval

C. Face Image Retrieval

The simulation results were obtained by using colour FERET face image database. 1050 faces of images used for training and different images from 30 volunteers were collected for the testing purpose.

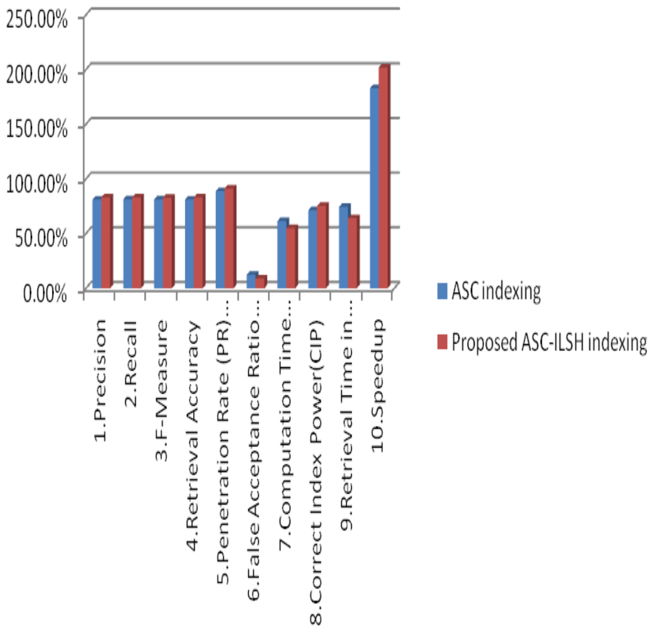

Fig. 4. Face Image Retrieval

D. Palm Print Image Retrieval

The simulation was conducted using PolyU palm print database. From the PolyU Ver.2.0 database, the total number of 1075 palm print images is used for training and 30 images from volunteers were collected for testing.

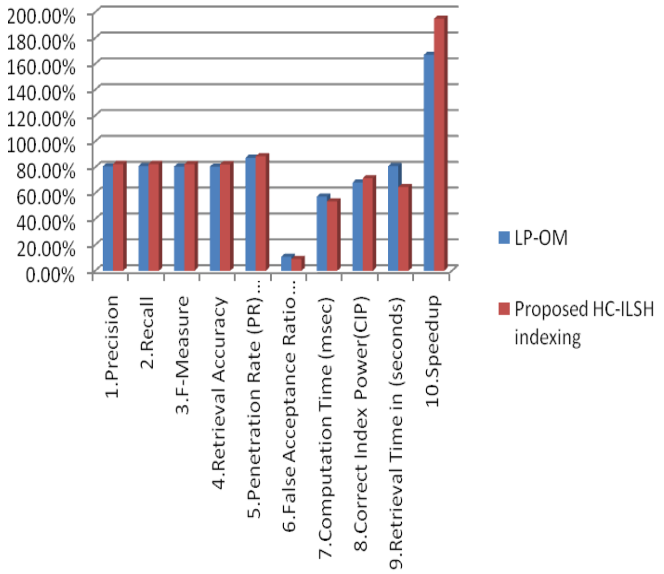

Fig. 5. Palm print image retrieval

E. Multi model biometric image retrieval:

The Multimodal based biometric image retrieval system is provided improved security and performance of the retrieval system. From table 4.1, it has been inferred that, the proposed Indexing Level Fusion (ILF) technique provided optimized performance compared with Score Level Fusion (SLF), Feature Level Fusion(FLF) and other conventional indexing schemes for biometric image retrieval system.

Table-I : Multi model biometric image retrieval

Parameters	MMBIR-SLF	MMBIR-FLF	MMBIR-ILF
1.Precision	0.904	0.916	0.93
2.Recall	0.9076	0.9184	0.9296
3.F-Measure	0.9062	0.9168	0.9286
4.Retrieval Accuracy	90.50%	91.74%	92.82%
5.Penetration Rate (PR) versus Correct Rate (CR)	89.20%	91.02%	92.58%
6.False Acceptance Ratio versus False Rejection Ratio	11%	10%	8%
7.Computation Time (msec)	89.34	86.16	79.54
8.Correct Index Power(CIP)	0.7996	0.8184	0.832
9.Retrieval Time in (seconds)	1.218	1.104	0.906
10.Speedup	117%	207%	217%

V. CONCLUSION

Biometric authentication is very much essential for security based system and human recognition system. Multimodal biometric image based retrieval system has been developed to increase the matching speed, accuracy, performance and to enhance the security of the retrieval system. The simulation results indicates that the multimodal biometric image based retrieval system using an indexing level fusion technique offers better performance in terms of different parameters like Retrieval Accuracy, Penetration Rate (PR) versus Correct Rate (CR), False Acceptance Ratio versus False Rejection Ratio, Precision, Computation Time (msec), Correct Index Power (CIP), Recall, Retrieval Time in (seconds), Speedup time as well as accuracy and F-Measure when compared with other uni-model biometric image based retrieval system and conventional multi biometric image based retrieval system.

Further the research can be done by considering the other biometric features and it can be implemented in real time based system.

REFERENCES

1. Binu, D., and P. Malathi. "Multi Model based Biometric Image Retrieval for Enhancing Security" Indian Journal of Science and Technology 8, no. 35 (2016).
2. Binu, D., Malathi, P., “Two modal Biometric based Content Based Image Retrieval Approach(TMB-CBIR) for Biometric Authentication”, Asian Journal of Information Technology, vol. 15, no.13, 2016, pp. 2154-2161.
3. D.Binu, M.Arun Athithyan, G.K.Felins, A.Mohammed Anish, D.Sathish Kumar,"Secure Bank Locker System with Biometric" in International Journal Innovative Research and scientific Technology ,March 2017,pp.85-89, (IJIRST/Conf/NCNICS/2017/017).
4. Gu, X, Zhang, Y, Zhang, L, Zhang, D & Li, J2013, ‘An improved method of locality sensitive hashing for indexing large-scale and high-dimensional features’, Signal Processing, vol. 93, no. 8, pp. 2244-2255
5. Jiang, X, Liu, M & Kot, AC 2006, ‘Fingerprint retrieval for identification’, IEEE Transactions on Information Forensics and Security, vol. 1, no. 4, pp. 532-542.
6. Kavati, I, Prasad, MV & Bhagvati, C2015, ‘Palm print retrieval based on match scores and decision-level fusion’, Proceedings of the International Conference on Advances in Computing, Communications and Informatics, pp. 1591-1595.
7. Chen, BC, Chen, YY, Kuo, YH & Hsu, WH2013, ‘Scalable face image retrieval using attribute-enhanced sparse code words’, IEEE Transactions on Multimedia, vol. 15, no. 5, pp. 1163-1173.
8. Jayaraman, U, Prakash, S & Gupta, P2012, ‘An efficient color and texture based iris image retrieval technique’, Expert Systems with Applications, vol. 39, no. 5, pp. 4915-4926.
9. Jain, AK& Nandakumar, K 2012, ‘Biometric Authentication: System Security and User Privacy’, IEEE Computer, vol.45, no. 11, pp. 87-92.
10. Shekhar, S, Patel, VM, Nasrabadi, NM & Chellappa, R 2014, ‘Joint sparse representation for robust multimodal biometrics recognition’, IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 36, no. 1, pp. 113-126.

AUTHORS PROFILE

Dr..D.BINU, is presently working as Assistant Professor (Selection Grade) at Sri Ramakrishna Institute of Technology, Coimbatore. Previously she worked as Lecturer in The Rajaas Engineering College,Vadakkankulam. She completed doctoral degree in the field of biometric image retrieval from Anna University, Chennai in the year 2018. Post graduate degree in the specialization of Applied Electronics from The Rajaas Engineering College, Vadakkankulam under Anna University, Chennai,in the year 2007. She received under graduate degree in Electrical and Electronics Engineering from Jayamatha Engineering College in Manonmaniam Sundaranar University, Thirunelveli in the year 2001.Totaly she has 15 years of experience in teaching field. She has published many articles in National and International Journals and Conferences. She is a member in ISTE and IAENG .

Mr.M.Vignesh, is presently working as Assistant Professor in the department of Electronics and Communication Engineering at Sri Ramakrishna Institute of Technology, Coimbatore. He hae 4.5 years of industrial experience in business Intelligence and Data Warehousing. He completed Post Graduate in PSG College Of Technology in the year 2014 and Under Graduate in KTVR Knowledge Park for Engineering and Technology in 2012.