Certain Investigations on Fuzzy K Means Clustering Algorithm for Multimodal Techniques Nail, Iris & Palm Print for User Authentication in Systems

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Abstract: Biometrics is a science and technology of measuring and analyzing human behavioral characteristics such as face, fingerprint, iris and palm print. These characteristics have been used for improving the security of a system. The new modality of nail based technique has been added to this multimodal concept. These all the biometric modalities produce a good authentication results. Generally uni modal biometrics having intra and inter class variations. These types of errors can be overcome by this multimodal concept. Initially these multimodal technique implemented in serial manner. Nail modality initially verified by the user if doesn't matched with the database un authorized user can't able to proceed. User input data satisfied with the database then the user allowed to verify the next modality iris. If it is matched then the user allowed authenticating the next modality or else the user is not allowed. Final palm print of the user has been verified and if it is matched with the database the respective user allowed to access the resource. In this proposed methodology security of the system or resource has been improved by using the multimodal biometrics.

Introduction:

In olden days system or resource security was maintained by using passwords. Due to large passwords users may not able to recall the passwords at the time of verification. Familiar passwords like data of birth, names are misused by some other persons. At extreme end the passwords are stolen by unauthorized users. In such situations biometrics concepts have been implemented and the security of the systems has been improved. These biometrics modalities are unique characteristics. These modalities are not forgottenby the users, and not able to stolen by some unauthorized users.Unimodal biometrics also having some limitations, such as intra , inter class variations and pose variations due to that security will be decreased. In such situation multimodal concept has been implemented. Multiple modalities have been used for authenticating a system which is called multimodal biometrics. There are so many modalities also introduced for authentication. Face, fingerprint, key stroke, iris, palm print and ear etc.

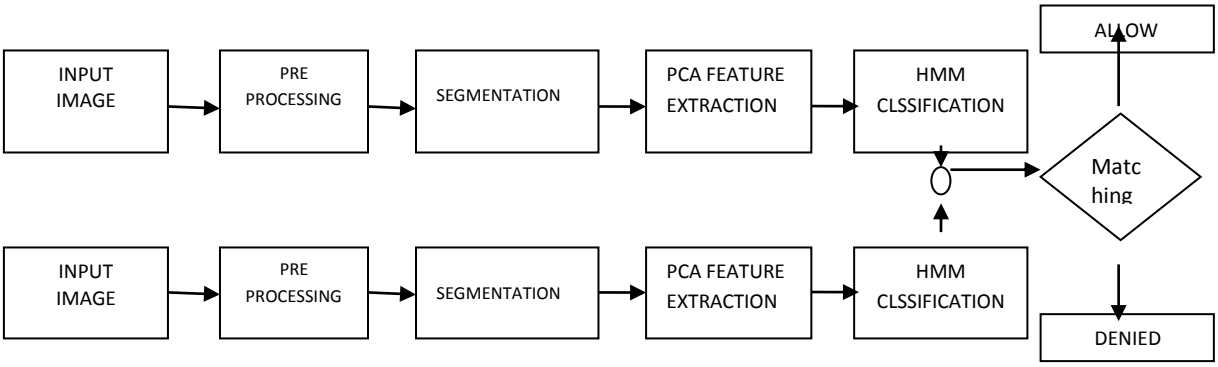


Figure1. Proposed Frame work of Authentication of Input Image with Database Image

These modalities also implemented in various combinations face with finger print , finger print with iris, iris with palm print. There are multiple number of combinations are used for authenticating a system. The olden concepts of systems using the fuzzy c means segmentation technique in each modalities and KNN classification technique for matching the users[1]. Some other combinations of the techniques are DWT for segmentation and KNN classification for matching the users. The above methods are producing a poor success rates. Here the proposed technique is the combinations of nail, palm print and iris modalities. Here the segmentation, Classification and matching is performed by the new combinations of fuzzy K means and Hidden markov model.

The proposed technique produce good results compared to other techniques. These combinations of nail, palm print and iris modalities are verified by serial mode of authentication[2]. Comparison graphs are shown in the results.

Proposed Framework:

There are three modalities used. Nail, palm print and iris. If any one biometric modalities fails then the user not allowed to proceed. Otherwise user allowed to next verification[3], it matches all the data stored in the database then the user finally allowed to access the system or resource.

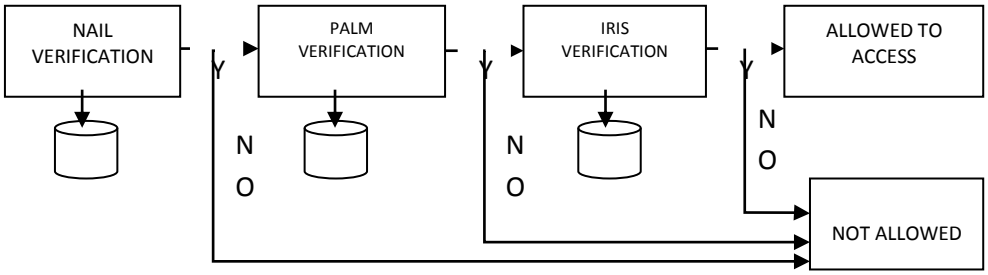


Figure2. Proposed Frame work of Multimodal Biometrics [Serial Verification]

This combination of Nail, palm print and iris biometrics provides a good result. Fuzzy k means with Hidden Markov Model success rates are better than the other combinations of segmentation with classification.

Data Sets:

Data sets are defined by collections of data. The actual observations are plotted in to data sets. The size of the images depends on the data s which we used. Nail modality data s are referred by Geo data sets.GSE 1685 accession data sets can be used for the nail verification. Palm print ICHB 2011 poly 2D+ 3D data sets used for palm print verification[4]. Finally CASIA data set images used for iris verification. The above data set images can be used for implementing a proposed multimodal authentication

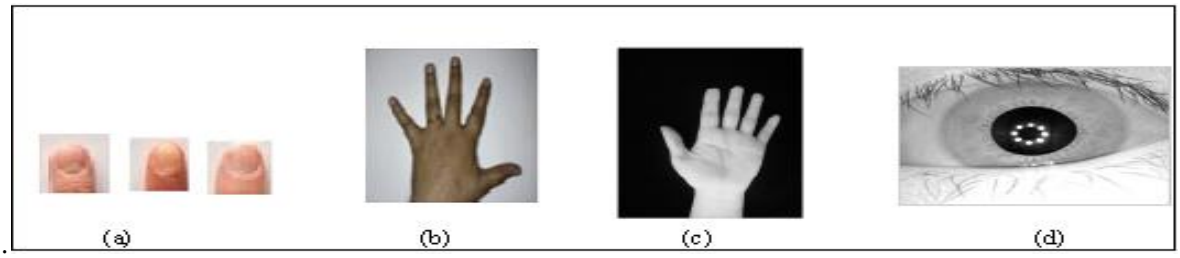


Figure 3. (a) Finger Nail Images (b) Palm Print Images (c) Segmented Palm Images (d) iris images

Pre Processing:

Input images of nail, palm print and iris can be collected by respective hardware devices. The collected input images are preprocessed initially. Pre processing is a technique to remove the unwanted parts in the images. Other finger portions are removed andnail image only extracted. It is shown in figure 3.Similarly palm and iris images are preprocessed. Eye yields, eye lashes will be removed by preprocessing[5]. The above said all the pre processing is done by the thresholding. Thresholdingcan be fixed by all the images.

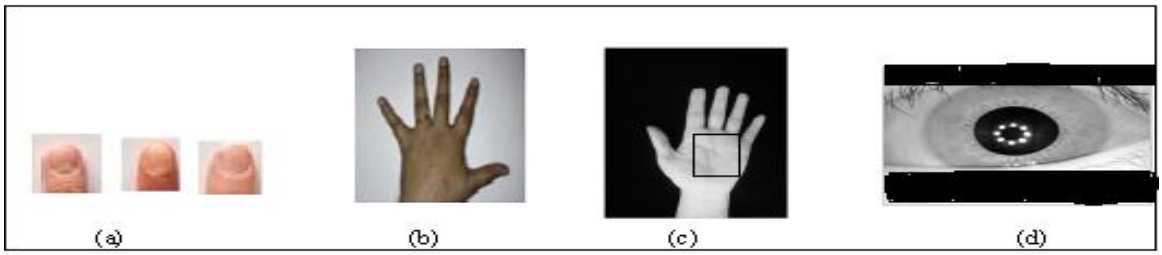


Figure 4. (a) Finger Nail Images (b) Palm Print Images (c) Segmented Palm Images (d) iris images

Fuzzy K means:

Fuzzy K means algorithm is used for clustering the images. It will cluster the images based on the characteristics. It is a numerical, unsupervised, non deterministic and iterative.

The K-Means Algorithm :

In the beginning the iris image will be pre processed.The same image will be measured as input data matrix X.The number of clusters will be k [6]. The cluster inside the data matrix will be defined by S_l (where l=1 to k).

step 1:

Set the initial values of p=1 and input clusters centre will be $sc_0=\{cj(0)\}$ .The € as minimum value.

step 2:

Euclidean distance will be calculated between the input matrix xi and centroid value cj

step 3:

Initially the membership can be find and it will be updated by Euclidean distance.

step 4

To avoid the centroid consider , each centroid value will be check with the € value. It is the minimum values which define initially.

step 5

The final value of clustered images like nail, palm print and iris.

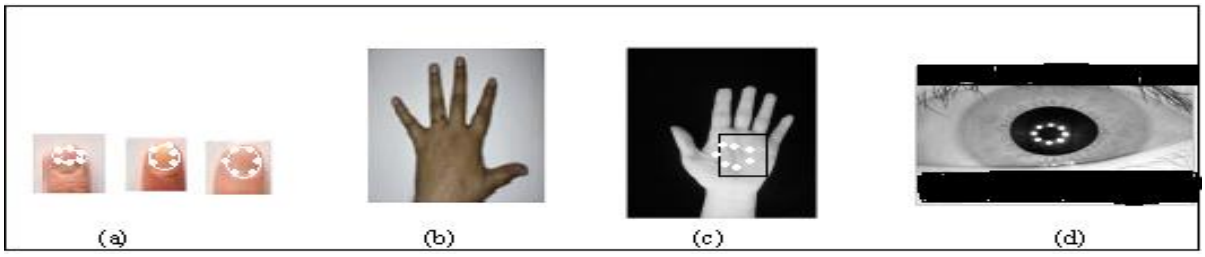


Figure 5. (a) Finger Nail Images (b) Palm Print Images (c) Segmented Palm Images (d) iris images

PCA:

PCA can be applied for clustered nail, palm print and iris images. Which can be used for collecting the features of each clustered images[7].

Step 1:

The k means clustering result matrix J will be taken as the input matrix for PCA process.

Step 2:

The mean value of the data in the given image pixels can be calculated.

Step 3:

covariance will be calculated for the 2 dimensional mean dataset. It will form the covariance matrix.

Step 4:

Since the covariance matrix is square, eigenvectors and eigenvalues are calculated for this matrix. These are rather important, as they tell us useful information aboutour data. These vectors are same. ie. Theirlengths are both 1.

Step 5: Eigenvectors are calculated from covariance matrix once in a time, then arrange the values from higher to lower.This values produces the components in order of consequence. If the eigen vectors will be choosen for feature vector the information may loss .If eigen vector will choose as lower values it won't be happen.then the feature vector can be form by using the vectors.

Step 6:

The feature set will be formed based on the information of Eigen vector i.e. feature vector and mean data set values. It can get by multiplying the feature vector with the zero mean vector.

Hidden markov model:

The output images of PCA features of nail, palm and iris can be matched with the database images in serial manner[8]. It can be done by using the HMM.

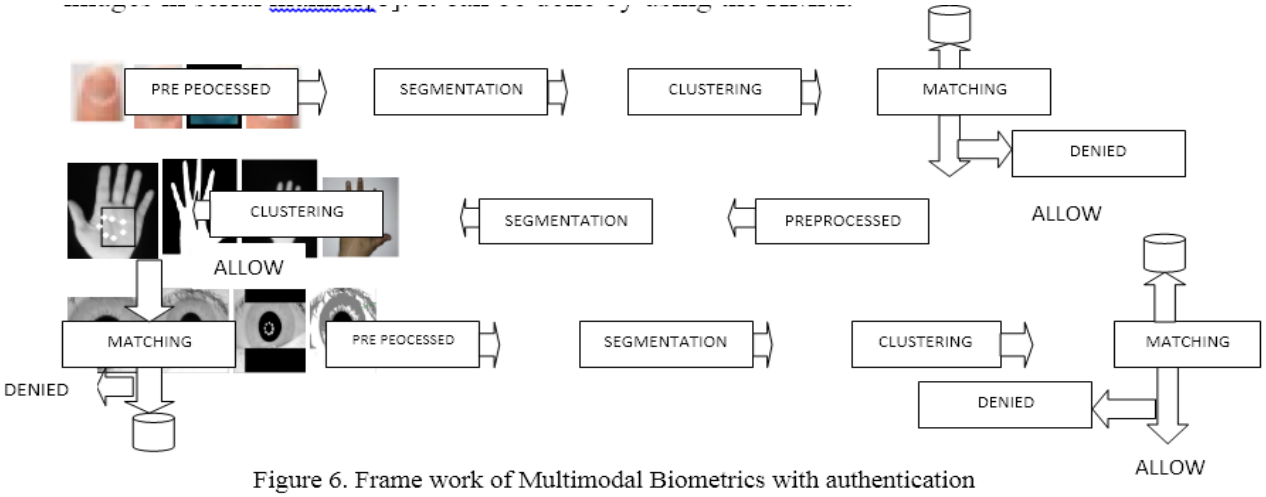


Figure 6. Frame work of Multimodal Biometrics with authentication

Experimental Results:

The experiment has been implemented in mat lab with various image data sets. This can also be implemented with real images taken by various users. Multiple modalities user for user authentication technique[9]. Nail, Palm print and iris can be used for user authentication. The common preprocessing, segmentation with fuzzy k means and KNN classification techniques user for authentication.

Table 1: Comparison of Various Approaches with Classification Techniques and Success Rate.

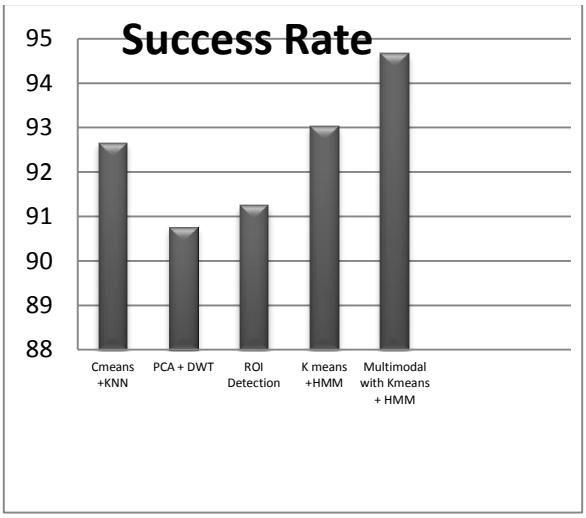
MODALITIES	SEGMENTATION TECHNIQUE	CLASSIFICATION/MATCHING TECHNIQUES	SUCCESS RATE
Unimodal	Fuzzy c means	KNN	92.65%
Unimodal	DWT	KNN	90.75%
Unimodal	ROI detection	Hamming distanced based matching	91.25%
Unimodal	Fuzzy k means	HMM	93.02%
Multimodal	Fuzzy k means	HMM	94.67%

Table 2: Comparison of Success Rates

S.No.	Techniques	Success Rate (%)
1	Fuzzy C Means Segmentation with KNN Classification	92.65%
2	DWT Segmentation with KNN Classification	90.75%
3	ROI Detection with Hamming Distance Based matching	91.25%
4	Fuzzy K Means with HMM	93.02%
5	Multi modal with K means HMM	94.67%

Table 3: Time Complexity of Clusters

S.No.	Fuzzy K Means	Fuzzy K Means with HMM	Fuzzy C Means
1	6341	4896	5634
2	11987	9460	23453
3	17865	14348	39896
4	22456	19478	59698
5	28986	23567	78000
6	35432	34356	97453
7	40234	34211	112345



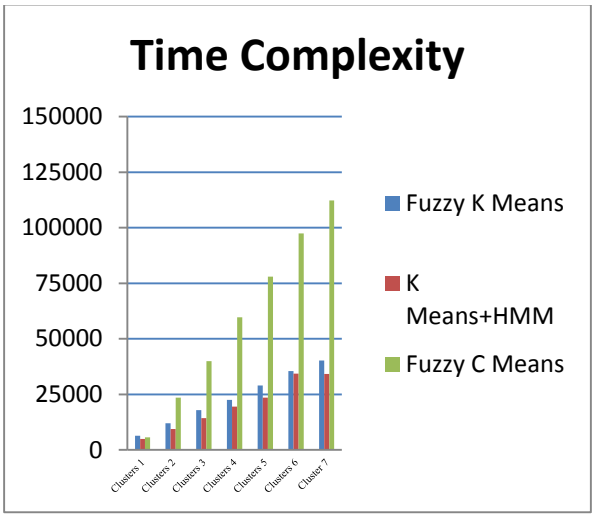


Figure: 7 Comparison of Success Rates

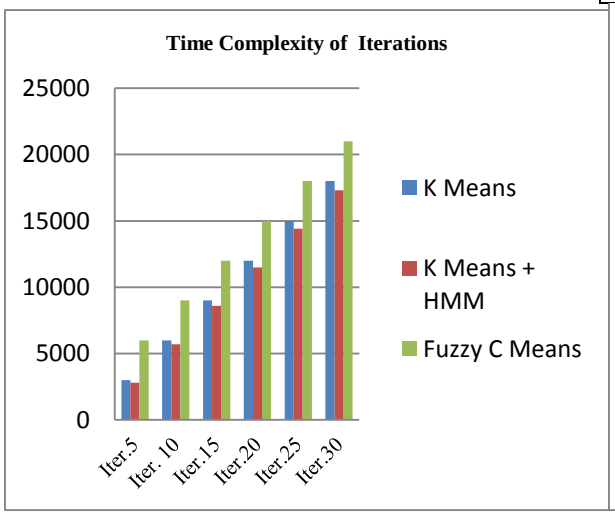
Figure: 8 Time Complexity Comparison

Table 4: Time Complexity of Iterations

S.No.	No.of Iterations	Fuzzy K Means	Fuzzy K Means with HMM	Fuzzy C Means
1	5	3000	2800	6000
2	10	6000	5700	9000
3	15	9000	8600	12000
4	20	12000	11500	15000
5	25	15000	14400	18000
6	30	18000	17300	21000

Table 5: Average Computation time in Seconds

S.No.	No.of Iterations	Fuzzy K Means	Fuzzy K Means with HMM	Fuzzy C Means	MCDFKM (M=1)
1	16	297.64	116.23	187.81	143.64
2	32	916.06	298.23	371.5	314.49
3	48	1534.48	480.23	555.19	485.34
4	64	2152.9	662.23	738.88	656.19
5	80	2771.32	844.23	922.57	827.04
6	96	3389.74	1026.23	1106.26	997.89
7	112	4008.16	1208.23	1289.95	1168.74



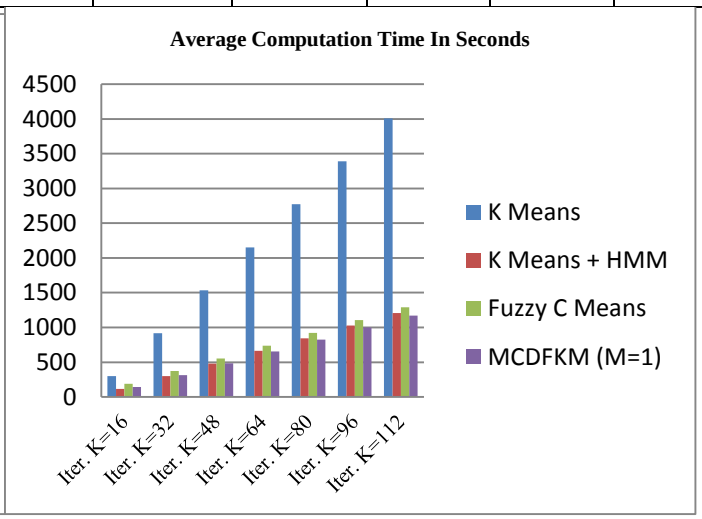


Figure: 9 Comparison of Various iterations

Figure: 10 Average Computation time in Seconds

The above implementation shows that the success rate of multimodal biometrics with fuzzy K means + HMM classification technique produces a 94.67% results shown in table 1.The time complexity of clusters will represented in the table 2 .There are seven clusters used in this proposed technique. Time complexity of iterations and average computation time in sequence can also be calculated and its shown in the tables.

Conclusion

The multimodal biometric system uses the various types of data sets for various modalities.For authenticating a nail based recognition Geo data sets can be used.GSE 201 can be used for palm print verification finally iris CASIA data sets can be used.All these types of modalities can be implemented with preprocessing, segmentation and classification with matching. Proposed technique used a multimodal fuzzy K means with HMM. The proposed technique produced the good results compared to its existing methods. It produces a 94.67% results and minimum no of computation time 0.029321.The proposed technique can also be implemented in real images by getting the respective hardware's in future.

References:

1. Amioy Kumar , ShrutiGarg, M. Hanmandlu "Biometric authentication using finger nail plates" Science Direct expert system with applications, Elsevier.
2. Soumi Ghosh., Sanjay kumarDubey "Comparative analysis of K-means and fuzzy c means algorithm", International Journal of advanced computer science and Applications.2013.
3. Liam, L., Chekima, A., Fan, L., and Dargham, J.: 'Iris recognition using self-organizing neural network'. IEEE, 2002 Student Conf. On Research and Developing Systems, Malaysia, 2002, pp. 169–172.
4. chih-tang chang1, jim z. c. lai2 and mu-der jeng1"A Fuzzy K-means Clustering Algorithm Using Cluster Center Displacement" Journal Of Information Science And Engineering 27, 995-1009 (2011).
5. Samuel p. Fenker, estefanortiz, and kevin w. Bowyer (fellow, ieee) "Template Aging Phenomenon in Iris Recognition"IEEE Access 2169-3536 May 2013
6. Sebastian Urban1, Justin Bayer1, Christian Osendorfer1,Göran Westling2, Benoni B. Edin2, and Patrick van der Smagt1 "Computing grip force and torque from finger nail images using
7. Gaussian processes" international conference on intelligent robots and systems proc IEEE 2013.
8. Dongjin Kwon, Student Member, IEEE, Il Dong Yun, Member, IEEE, and Sang Uk Lee, Fellow, IEEE Rolled Fingerprint Construction Using MRF-Based Nonrigid Image Registration IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 19, NO. 12, DECEMBER 2010
9. E. Mattar,"Principal Components Analysis Based Iris Recognition and Identification System"International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-3, Issue-2, May 2013.
10. K. Jain, R. Bolle, and S. Pankanti, Biometrics: Personal Identification in Networked Society,Kulwer Academic, 1999
11. G. Kwang, R. H. Yap, T. Sim, and R. Ramnath, "A usability study of continuous biometrics authentication," LNCS, vol. 5558, pp. 828–837,2009.
12. W. Shu and D. Zhang, "Automated personal identification by palmprint," Opt. Eng., vol. 37, no. 8,pp. 2359-2362, Aug. 1998.