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Score Level Fusion of Multispectral Palmprint with Triangular Conorm

Maria Afzal*, Mohd Abdul Ahad, Jyotsana Grover
Department of CSE, Jamia Hamdard,
Delhi, India

Abstract-

Biometric play vigorous role in the authentication of user by using his/her physical body traits. Unimodal biometric system uses single body traits and multimodal systems use multiple body traits. Multimodal biometric system have overcome the disadvantages that has occurred in unimodal systems. In this paper we are fusing the different spectral bands of palm print (Red, Green and Blue) using T-conorm operators like Hamacher, Frank, Probabilistic and Scheiwer & Skylar.Experiment Results suggest that Scheiwer & Skylar gives the best results. Experimental Results ascertain that the proposed approach for the score level fusion outperforms the state-of-art.

Keywords- Unimodal Biometrics, Multimodal Biometrics, Score Level fusion, Triangular conorm, Multispectral Palmprint.

I. INTRODUCTION

In today's era where data is a crucial entity, data became a liability for an organization if not protected well[4]. Biometric systems are one of successfully used measure for user authentication. These systems use body trait of users to recognize them. Biometric systems based on physiological and behavioural body traits like fingerprint, hand print, face, iris, voice, signature and palm-print are successfully used for authentication. Unimodal biometric systems use single body traits to authenticate its users. They have downsides like noise, defencelessness of results, distortion, risk of spoofing and others [1,2,3]. Multimodal biometric fuses more than one biometric trait and it overcome the demerits of unimodal biometric system. Fusion in multimodal biometric system performed at Sensor level, Feature level, Rank level, score level and at Decision level. In this paper we are performing the score level fusion multispectral palm-print (Red, Blue and Green).

II. RELATED WORK

Work on fusion and recognition of multispectral palm-print have been done so far.In [5] different bands were selected from the original four bands of Red, Green, Blue and Infrared from the multispectral palmprint data of PolyU (Hong Kong). For extraction of different bands extended general colour image discriminant (GCID) model was used, where three discriminate colours were obtained to improve the accuracy of recognition. In [6] a technique was proposed to extract ROI from multispectral palmprint that utilize the valley shape between fingers. In proposed scheme after extraction of ROI information from different spectral bands were integrated with the help of wavelet transform from various sub bands. Then statical dependency analysis were performed between sub bands to perform fusion either with selection or with weighted fusion. Kernal Discrimination Analysis (KDA) was used to reduce the dimension before applying Sparce Representaion Classifier (SRC), then feature were extracted using Log-Gabor filter.In [7] a multispectral palmprint recognition method was developed based on a hierarchical idea. This work was divided into two parts first part constitute the extraction of Block Dominant Orientation Code(BDOC) as a rough feature, and then the Block based Histogram of Oriented Gradient (BHOG) as a fine feature.In second part a hierarchical recognition approach was proposed based on two types of featutres extracted in first part. Then finally the fusion of features of different bands were performed to improve the accuracy.In [8] an investigation for the use of concavity feature in different orientation of palmprint recognition.

III. PROPOSED APPROACH:

In above discussed earlier work, we have seen that, it was done on the different extraction methods of feature extraction from multispectral palmprint (Red, Green and Blue) [5-8].In this paper we are performing score level fusion of multispectral palmprint using triangular conorm. Earlier work on score level fusion has been done on triangular norm [2-3]. In this approach we are using t-conorm like Frank, Hamacher, Schweizer & Skylar and probablistic.

A. Preleminaries of t-norm and t-conorm

Triangulat norms (t-norms) and Triangular conorms (t-conorms) are the functions are the families of binary function. These functions satifies the properties of conjuction and disjunction [3]. T-norm and t-conorm functions are used in fuzzy logic [2] [10]. T-conorm is dual of t-norm [10].

A t-norm is expressed as: $T: [0, 1] \times [0, 1] \rightarrow [0, 1]$ and satisfies the following properties:

1) Neutral Element: $T(1, a) = a$, for all a.

2) Monotonicity: $T(a, b) \leq T(a, b)$, if $a \leq b$, $a \leq b$.

3) Symmetry: T(a, b) = T(a, b), for all a and b.
4) Association Law: T(a, T(b, c)) = T(T(a, b), c), for all a, b, c.

A t-conorm is expressed as: S: [0, 1] x [0, 1] → [0, 1]. T-conorm satisfies the following properties [10]:
1) Neutral Element: S(0,a) = a for all a
2) Monotonicity: S(a,b) ≤ S(c,d) if a ≤ c and b ≤ d
3) Symmetry: S(a,b) = S(b,a), for all a and b
4) Association Law: S(a,S(b,c))= S(S(a,b),c) for all a,b,c.

T-conorms which we have used for our work:
1. Probablistic : $[1-(1-x)(1-y)]$
2. Hamacher: $1-\frac{(1-x)(1-y)}{[2-x-y-(1-x)(1-y)]}$
3. Frank (p>0):$[\ 1-log_p(1+\frac{(p^{(1-x)}-1)(p^{(1-y)}-1)}{p-1})]$
4. Schweizer & Skylar (q>0): $(x^q+y^q-\ x^q y^q)^{1/q}$

B. Score level Fusion

Score level fusion is performed on the matching scores of the feature vectors. Euclidean distance were used to calculate the scores. User vector is matched with training image. If user score is less than predefined threshold (α) than user is genuine or it is imposter.

IV. RESULTS AND DISCUSSIONS

Score level fusion for multispectral Palmprint is tested on the dataset of PolyU (Hong Kong) [9]. Here error rates are observed for data set after fusion of scores. Error rates are False Acceptance rate (FAR) and False Rejection Rate (FRR). FAR is the ratio of number of successful attempts to the total number of deceiving attempts. FRR is defined as the ratio of number of rejected attempts to the total number of attempts by the qualified user [2-3].

In our work we performed the score level fusion of different scores of multispectral palmprint i.e. scores in Red, Green and Blue light. The results are shown in Table 1, with Far of 0.01% , GAR (1-FRR) is 99.8% for probabilistic t-conorm, 99.7% for Hamacher t-conorm, 99.8% for Frank t-conorm and 99.9 % for Schweizer & Skylar t-conorm. We have compared the error rates (FAR and GAR) with ROC (Receiver operating characterstics) i.e FAR vs GAR Graph. ROC for different T-conorm functions that are Probabilistic, Hamacher, Frank and Schweizer & Skylar, are shown in Fig 1 to Fig 4. Where error graphs of fused scores with individual scores can be compared. We have compared our method with SVM, sum rule, product rule. It can be seen from the Table 1 that T-conorm outperform these methods.

Table1:Score level fusion of MultispectralPalmprintswith FAR=0.01%

Method	***GAR (%)***
ProbabilisticT-conorm	*99.8*
HamacherT-conorm	*99.7*
Frank T-conorm	*99.8*
Schweizer & Skylar T-conorm	***99.9***
Sum rule	*98.54*
SVM	*98.6*

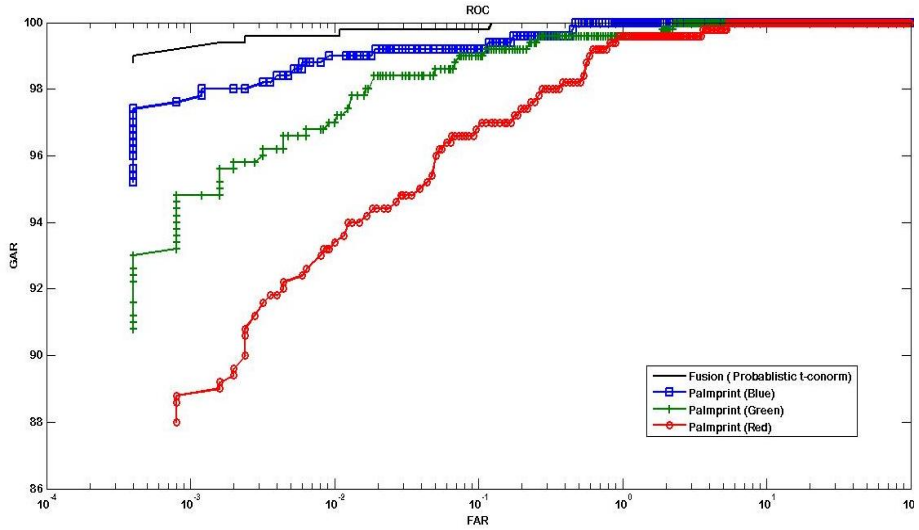

Fig 1: Score Level Fusion of Multispectral Palmprint with Probabilistic T-conorm

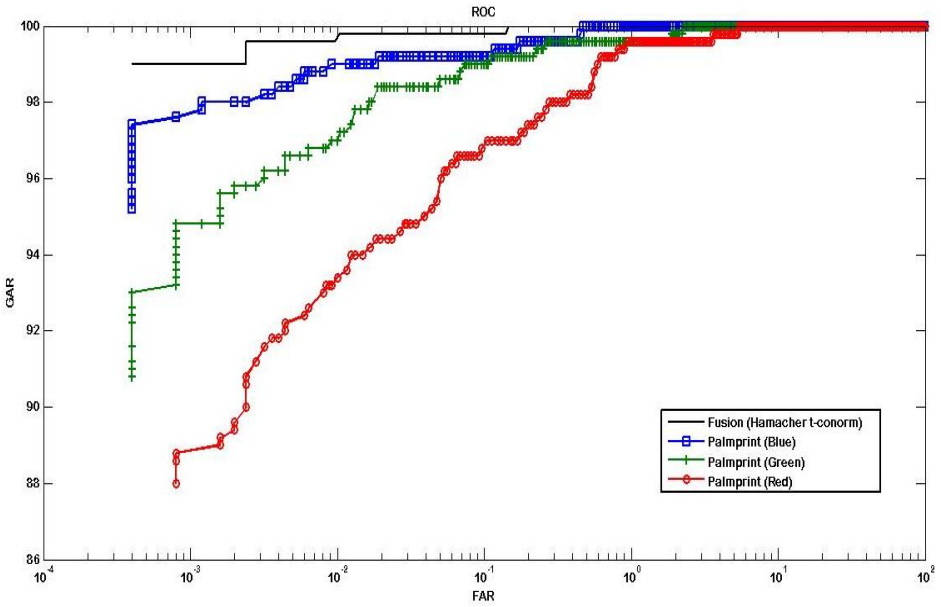

Fig 2:Score Level Fusion of Multispectral Palmprint with Hamacher T-conorm

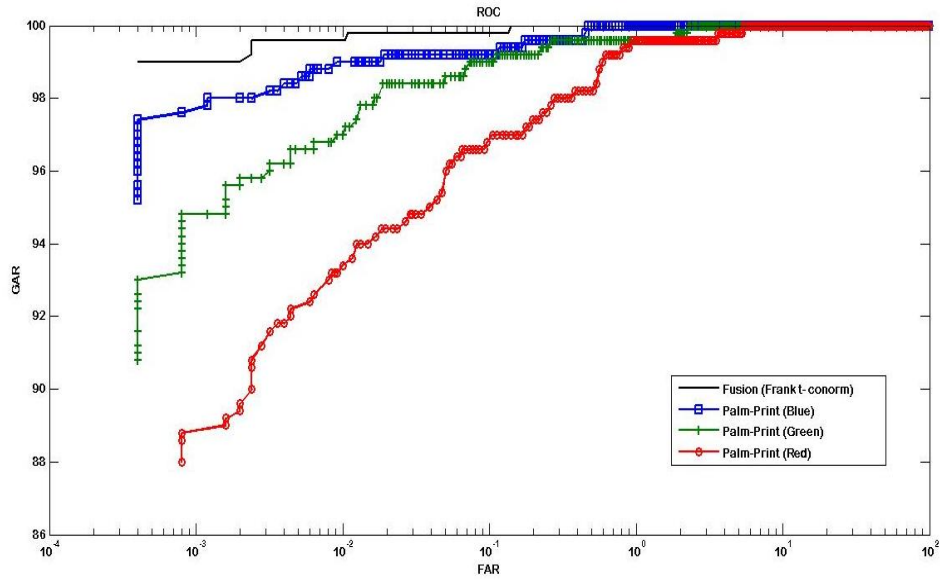

Fig 3: Score Level Fusion of Multispectral Palmprint with Frank T-conorm

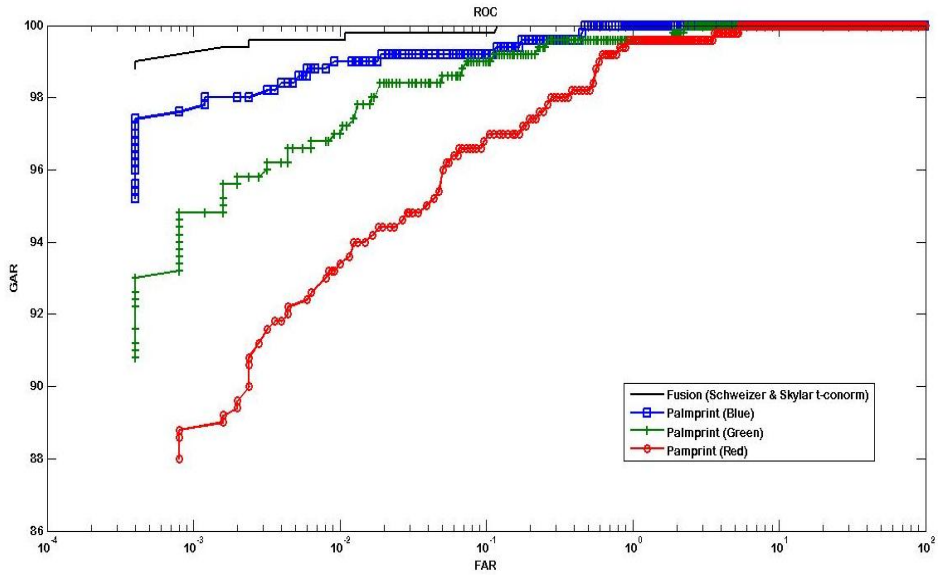

Fig 4: Score Level Fusion of Multispectral Palmprint with Schweizer & Skylar T-conorm

V. CONCLUSION

In this paper Score level fusion of Multispectral Palmprint is performed using different T-conorm operatorslike Probabilistic, Hamacher, Frank and Schweizer & Skylar on the palprint dataset of PolyU (Hong Kong) [9]. Previous works of score level fusion has been done using t-norm. Future work can be performed using some other functions for fusion. Triangular norm and Triangular conorm are binary functions used in fuzzy. Above methodology can be adopted for fusing other biometric modalities like Finger-print, Iris, Voice and Others

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