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Review of Fingerprint Recognition Techniques

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***Abstract*-- Biometric system that uses a single biometric indicator always uncomfortable with noisy data in user verification process. There is some kind of restriction on degree of freedom, some unacceptable error rates. With existing of these problems it's very difficult for particular to improve the performance a biometric system. Biometric fusion mostly applied on thumb impression but now days a speech by human, iris and ear data also used. In this paper we are going to use biometric fusion techniques on fingerprint data and then with the comparison of results find a conclusion which one better. Fusion of fingerprint could be occurring either before or after matching features of finger impression data. The presented research paper deals with the comparative study of different techniques which performs fusion of information after matching.**

***Keywords*-- Biometric Fusion, Feature level fusion, BFS, PSO, GA**

I. INTRODUCTION

Finger-scan technology is the most widely deployed biometric technology, with a number of different vendors offering a wide range of solutions. Among the most remarkable strengths of fingerprint recognition, we can mention the following:

- Recognition accuracy for high level is provided by maturity.
- There are many applications that prefer this technique due to small size and low cost, e.g., electronic commerce, physical access, PC logon, etc.

On the other hand, a number of weaknesses may influence the effectiveness of fingerprint recognition in certain cases:

- In case of injuries some factors working, can result in certain users being unable to use a fingerprint-based recognition system, either temporarily or permanently.
- In portable device sensors are embedded that may result in less information available from a fingerprint and/or little overlap between different acquisitions.

II. FEATURE LEVEL FUSION

When feature point are taken from any other source of information then process of feature level fusion occurred. The feature point that is concatenated and makes a set that is well performer as compared to a single vector of feature. For concatenation of feature pints we have follow a procedure that described [2] as below:

1. Feature set compatibility and normalization

For concatenation of feature points, it is necessary that feature point sets must be compatible. Like some feature point are compatible with SIFT feature points that known as minutiae feature point set. Concatenation can be done with making it rotation and translation invariant and introducing the key point descriptor.

Feature Reduction and Concatenation

Basic concept to implement feature level fusion is by concatenating the two feature point sets. With this preformation a set of fused feature point generated as below:

concat=(s1norm,s2norm,…smnorm,….m1norm, m2norm, mmnorm).

Irrelevant feature can be eliminated by using a method of Feature reduction. It can be applied before or after feature concatenation.

III. FUSION METHODS

There are so many methods or techniques that can be used for fusion as following:

1. Brute Force Search (BFS)

In the case of two matchers this technique is commonly used. The following equation is base of this technique

$$u = x_1 w + x_2 (1 - w)$$

Where the fused score is represented by u, the ith normalized the feature for matcher score is represented by xi, w is a weighting factor in the range [0, 1], we have to minimize equal error rate (EER) [3] for which we need to calculate value of w using an exhaustive search.

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2. Genetic Algorithm (GA)

Genetic Algorithms are used to get optimum solutions in multi-dimensional space. This algorithm has to prove in providing best solution without worrying about local minima relying on an elite preservation strategy. Many investigations are performed in last many years for optimization problems, in the literature [4].

Generally the following procedure is used for generating simple form of the genetic algorithms is summarized as follows:

- Generate random population of n chromosomes(suitable solutions for the problem)
  w0i, i = (w1, w2) i = 1...N
  where N : size of population
- fitness f(x) of each chromosome x in the population is used for evaluation
  $$EER(u = w_1x_1 + w_2x_2)$$
- These following steps repeat for creation of new population until the new population is complete.

3. Particle Swarm Optimization (PSO)

Particle swarm optimization (PSO) is a similar technique with Genetic Algorithm (GA). Basic of this technique is population. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, every solution resulted by this algorithm is like a “bird” (particle). For finding the fitness value for all of particles, a fitness function is evaluated that to be optimized. This function has velocities which direct the flying of the particles. At initial point of PSO, a group of random particles (solutions) selected and then our work starts to search for optima by updating generations using the following equations:

$$v[\,] = v[\,] + c_1 * rand() * (pbest[\,] - present[\,]) + c_2 * rand() * (gbest[\,] - present[\,]) \quad (4)$$

$$present[\,] = present[\,] + v[\,] \quad (5)$$

IV. Comparative Result

Figure 2 provides a summary comparison of the four techniques on 2-way fusion problems constructed from the following feature for score sets:

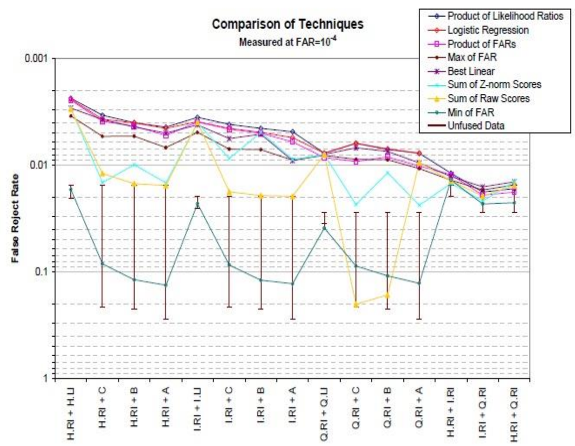

Figure 2: Eight selected techniques compared at FAR=10^{-4} on a variety of fusion tasks. Product of Likelihood Ratios performs consistently well.

Some results are as following:

- Simple sum of raw scores performs well when the scores are of the same type (the same matcher on corresponding fingers). Results remain variable.
- Min of FAR is not effective.

Additionally, it should be noted that

- The probabilistic techniques are often sensitive to accurate modeling of the score distributions and implementation. This may be a significant consideration when selecting a technique for a specific application.
- The findings of this study disprove the oft-repeated canard that decision-level fusion is ineffective: decision-level fusion was found to be highly effective, but we cannot say it is more effective than a score-level fusion. Ratios should perform better than Max of FARs but not as well as the product of likelihood ratios. This was not verified empirically.

Figure 3 and Figure 4 provide sets of complete ROCs to show how the various techniques compare [6] across the range of operating thresholds.

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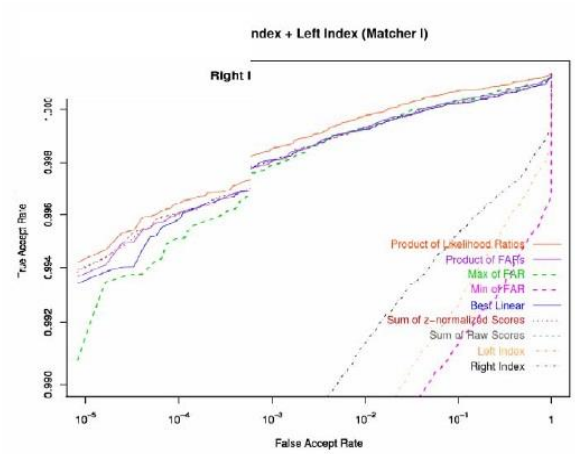

Figure 3: The result of fusing two different fingers using the same matcher.

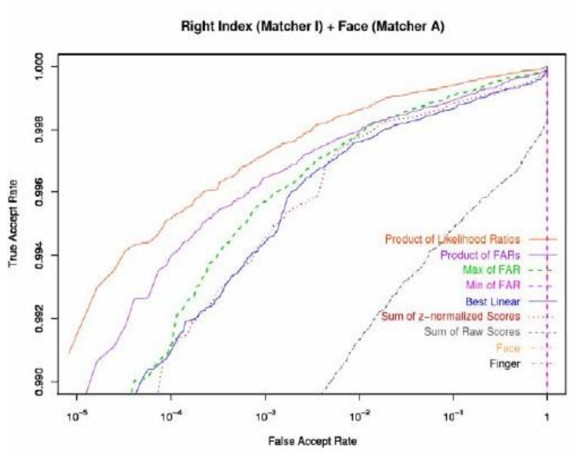

Figure 4: The result of fusing a match score and a finger score.

V. CONCLUSION

There are many techniques available in market some of them we have studied in this paper on feature level fusion. We evaluated results and compared in this study. An important consideration when making a selection is what tools and information are available for modeling the score distributions. So as we have to apply these techniques on speech, iris and ear data. An important consideration when making a selection is what tools and information are available for modeling the score distributions. If we discuss about most sophisticated and accurate technique that is product of likelihood ratios which is implemented. For feature distribution there is requirement of careful modeling.

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