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Multimodal Biometric Recognition Using MBC Technique

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ABSTRACT: In the recent past researchers are concentrating on multimodal biometrics for improving the recognition accuracy. It is a well-known fact that fusion provides higher recognition accuracy in multimodal biometrics. Fusion is of different types wherein feature fusion creates a finite set of features which are prominent enough such that the final fused feature vector will be of shorter length providing higher recognition accuracy. Further, decision level fusion is another type of fusion which fuses the decision provided by each classifier and outputs a final decision based on which recognized class is taken as output. Next type of fusion is Rank level fusion which is observed to outperform the previous level fusion techniques. In this paper it is proposed to use rank level based fusion for classification in multimodal biometrics. Each classified output is given a rank using the existing borda count method is modified and used for assigning ranks. Results show that the proposed technique outperform the existing decision level and feature level fusion techniques. Results show that the recognition accuracy is observed to be 99.9% and the time taken in recognition is found to be 0.37 seconds in a database of 100 classes of multimodal biometrics.

KEYWORDS: Multimodal Biometrics, Decision level fusion, Feature level fusion, Rank level fusion, Borda count method.

I. INTRODUCTION

In the recent past biometric systems have been introduced in many areas which provide security and authenticate humans. These biometric systems offer identity management based on which access control is provided to the users. But these systems tend to have less performance depending on the operating environment which include noisy data that is received from the sensors, same class variation data that is available from same user, common feature sets from different users and so on. Hence, Multibiometric systems are suggested which solve some of the limitation that are posed by the use of one biometric or unimodal biometrics. Such multimodal biometrics use multiple sensors, samples and algorithms for processing of these traits. In order to improve the performance of biometric systems, different levels of fusion are proposed in literature. They are feature fusion, score fusion, rank level fusion and so on. In this paper we propose to use rank level fusion. Figure 1 shows the basic block diagram of a multi modal biometric system using rank level fusion.

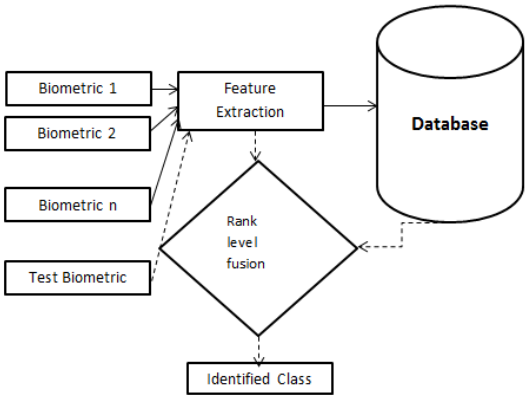

Figure 1. Block diagram of a general rank level fusion

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II. LITERATURE SURVEY

Systems based on Multibiometrics combine evidences from multiple biometric sources that result in better recognition accuracy. When the quality of the image is assessed and if such information is combined with the fusion information rule, it is observed to have better performance in rank level fusion. It is also observed that the performance of classical rank based schemes rely on the input data which may be of low quality and incorporating such low quality data results in low performance of the system[1]. In the absence of the ranked features, k partition of the template can be used as features. This approach is observed to boost the confidence levels by the use of partition information. This is used for generating ranks. Ranks that are generated are used for the estimation of the fused rank for classification[2]. A nonlinear rank level fusion approach is proposed which presents a comparative study of rank level fusion that combines multibiometrics fusion. It is observed that the nonlinear rank level approach outperforms the existing approaches[3]. There are different biometric traits which are used for authentication. Palmprint is one such biometric which is used to authenticate humans. Rank level combination is implemented using different approaches, viz., Borda and weighted borda count, highest rank etc. A novel non linear way of combining ranks is proposed which is observed to be having higher performance when compared to the existing techniques[4]. It is well known that integration of modalities extracted from a person will increase the performance of the biometric system. In this process two modalities like facial thermogram and ear are extracted from a user and rank level fusion is applied. It is observed that such a integration has provided an acceptance rate of 98% with a FAR of 0.1%[5]. The ranks that are generated from various biometric modalities like face, ear and signature are used for authentication and are further combined and applied rank level fusion. It is observed that out of the various rank level fusion approaches logistic regression provides better performance[6]. The existing techniques concentrated on a database of images which are pre processed such that they are standard in nature. Monwar et al.[7] has considered such challenging conditions which include motion, low resolution, de focus, occlusion, blur etc which degrades the performance of the system. Further rank level fusion is applied and showed improved performance. A new multimodal cancelable biometric which is based on the combination of ear and face is proposed and futher rank level fusion is applied. Multi fold random projection is used and further the features that are extracted are reduced using PCA[8]. Multi spectral resolution of any biometric system may enhance the features that are extracted from the biometrics[9]. Fusion plays an important role in the performanc of multi biometric system. Probability resemblance is taken in to consideration prior to testing and ranks are assigned. It is observed that the performance of the system increased with fusion approach[10]. Rank level fusion has been extended and is applied over various domains. It is applied to estimate the failure modes in hard drives using neural networks based rank level fusion[11].

III. PROBLEM DEFINITION

Multimodal biometrics are observed to have increased performance when compared to unimodal biometrics. Individual decisions that are provided from a single decision based classifier is not valied based on the nature of the similarity in the biometric features that are extracted from the biometric modalities. It is further to be noted that in the case of multimodal biometrics the features that are combined to form the final feature vector may be having higher similarity, hence, rising the need for fusion techniques. Various fusion approaches exist in the recent past which have been applied in biometric systems, but still, there is a requirement to enhance these fusion approaches.

IV. PROPOSED SOLUTION

In this paper we propose to use rank level fusion. The introduction section clearly explains various types of fusion techniques. Out of which rank level fusion is considered here owing to its advantages in contrast to its counterparts. In rank level fusion, output from various biometric devices are ranked and their information regarding the features or score level values are not made visible, making them secure. It is also aware from the survey of the past works that rank level fusion is more suitable for multimodal biometrics.

V. METHODOLOGY

Initially the system that is designed in this work is based on the multimodal biometrics. Fingerprint and Iris are the two biometrics that are used in this work. CASIA[12-13] database is used in this work. Features are extracted from each of the biometric and are stored in the database. Different features viz., GLCM[14], LBP[16] and Gabor filter[15] features are extracted from each biometric and are stored against the index values of each biometric in a database. Further it is tested using a distance based classifier. The result of the distance based classifier given an output as the distance

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between the test case vector and the trained vectors. It is nothing but a conventional technique which classifies the given test case based on the distance which is shown in figure 2.

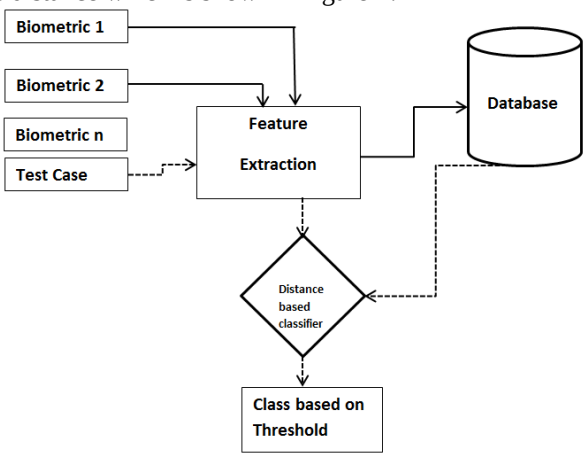

Figure 2 Conventional distance based classifier based biometric system.

The accuracy of such a system may be hindered under different conditions. Hence, in order to improve the accuracy of the system it is proposed to apply rank level fusion by assigning ranks to the test case vector by having the knowledge of the trained vectors. Various methods or techniques exists in literature for rank level fusion[3]. Generally known technique for rank level fusion is Borda count approach which takes the majority vote an assigns rank to the given test case, which is an unsupervised rank level fusion technique[3]. The problem with such an assignment of ranks using borda count technique does not reduce the systems complexity. The results section shows the output of the ranks that are provided in this project using borda count technique. All the trained cases have been assigned ranks. In this work as we have considered only 100 classes, this technique has provided only 100 ranks but such a technique will be of invain when it is considered to have a database with 130 crores, wherein the assignment of ranks itself takes longer time than usual which increases the computational complexity of the system. This problem is exploited in this work and we try to reduce this ranking mechanism and this technique is coined as Modified Borda Count method.
In order to reduce the number of ranks, the mean distance is computed and then it is used as a threshold to reduce the number of trained vectors to be separated from the existing trained vectors, resulting in reduction of the trained vectors. In this work, we have proposed to use a feedback loop such that a maximum number of only 10 ranks need to be issued at the end of the output. Figure 3 shows the block diagram of the proposed MBC technique.

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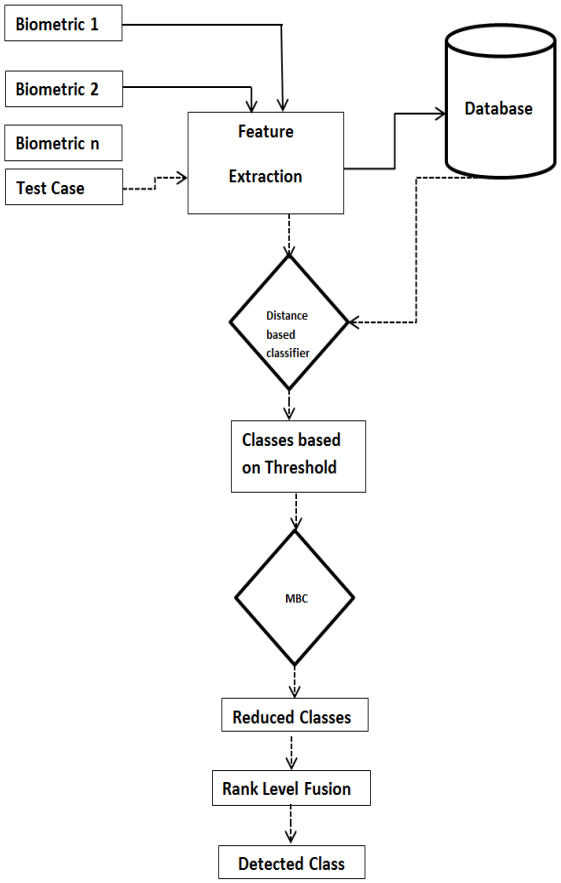

Figure 3 Block Diagram of the proposed technique

VI. RESULTS

Figure 4 shows the snapshot of the database[12-13] used in this work.

Figure 4. Database used in this work

Different features are extracted from each of the biometric and are concatenated to form the final feature vector. In this work only one type of classifier is used which is a distance based classifier. The out put of the classifier is taken and borda count method is applied to give the ranks to the detected classes and the number of classes that are provided by the distance based classifier are the trained vectors and will be the number of the ranks. Hence, these ranks should be reduced. Figure 5 shows the ranks provided by the borda count method.

Figure 6 shows the output of the modified borda count method which shows the reduction in the number of classes that are considered for final ranking. It can be observed from figure 6 that the number of final detected classes reduces,

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hence the computational complexity of the system also reduces. This will be an advantage when a large database is considered.

Further the final decision is made using the mimimum rank provided in each of the biometric and are combined to take the maximally repeated value as the output class

```
iris_rank_bc =

     1     1
    58     2
    57     3
    63     4
    78     5
    53     6
    56     7
    94     8
    72     9
    76    10
    70    11
     4    12
    32    13
    15    14
    44    15
    48    16
    65    17
    23    18
     2    19
    80    20
    14    21
    68    22
    29    23
    50    24
```

Figure 5 Ranking Using Borda Count Method.

```
iris_final_rank_mbc =

     1     1
    57     2
    58     3


finger_final_rank_mbc =

     1     1
    11     2
    21     3
    32     4
    33     5
    91     6
    98     7

final recognised class...

C =

     1
```

Figure 6 Final Ranks Using Modified Borda Count Method.

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Figure 7 and 8 shows the output screenshot of the proposed technique resulting in the reduced number of classes as the output.

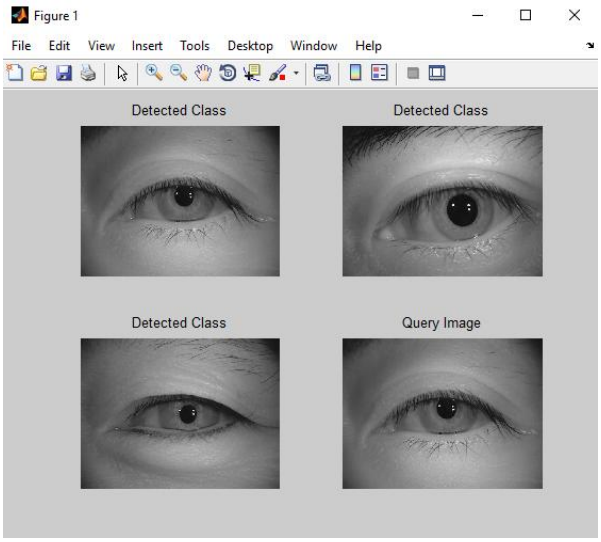

Figure 7 Recognized class from Iris biometric using proposed technique.

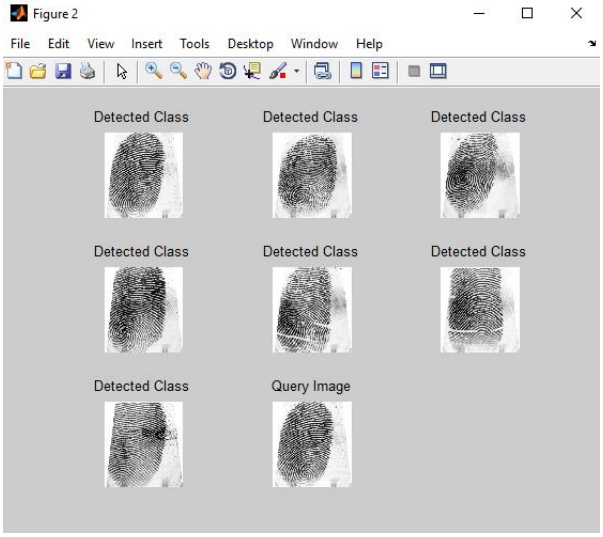

Figure 8 Recognized class from finger biometric using proposed technique.

It is also observed that the time taken for te existing technique of using borda count method has taken more time as the number of ranks that aare to be assigned will be more and the number of ranks that are to be assigned using modified boda count method will be less, hence, less time complexity in this case. Hence, it can be concluded that the proposed technique results in the less time in processing the given biometric data.

VII. CONCLUSION

Biometric systems which use multimodal traits tend to offer high accuracy over unimodal counterparts. In this paper we propose a novel approach which uses modified borda count method which takes the mean of the feature values into consideration, which is used as a threshold every time to reduce the number of ranks that are to be issued to a user based on the distance between the test vector and the trained vectors

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in the database. This technique is shown to have reduced number of ranks that are to be assigned while increasing the recognition accuracy of the system. It is also observed that the time in such elimination process does not have any delay in recognition time. Hence, the proposed technique is said to be highly accurate when a large database is considered. Results show that the recognition accuracy is observed to be 99.9% and the time taken in recognition is found to be 0.37 seconds in a database of 100 classes of multimodal biometrics.

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