Palmprint Template Protection Scheme with Matrix Transformation

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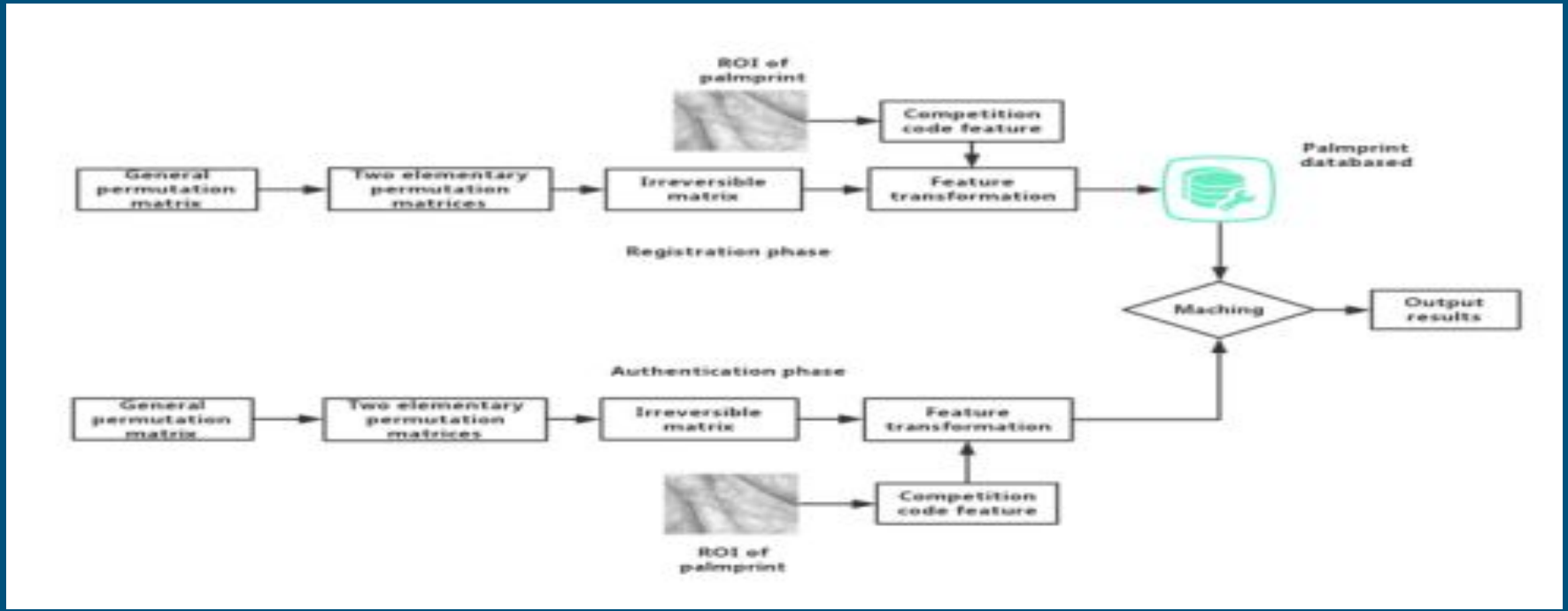
About

Firstly, the competition code features of original palmprint is extracted through the Gabor filters. Then, a general permutation matrix is generated randomly and two elementary permutation matrices are obtained by changing any two rows of it. Nextly, irreversible matrix is generated by XORing operation. Finally, cancelable palmprint templates are produced by multiplying the irreversible matrix and the original palmprint feature. The experimental results show that our cancelable palmprint scheme can not only ensure high safety but also meet the recognition accuracy requirements.

Summary

The proposed system:



Identification/Authentication Scenario

Identification Scenario

First we analyse the identification scenario, which corresponds to 1:M classification problem. Biometric identification answers the question “Who are you?”. It is usually applied in a situation where an organization needs to identify a person. The organization captures a biometric from that individual and then searches in a database in order to correctly identify the person.

Authentication Scenario

Second, we analyse the authentication scenario, which corresponds to 1:1 problem or binary classification. The question that is asked is: “Can you prove who you are?”. A system will challenge someone to prove their identity and the person has to respond in order to allow them access to a system or service. For example, a person touches their palm on a sensor embedded in a smartphone, used by the authentication solution as part of a challenge/response system.

Results

Multiclass SVM Model

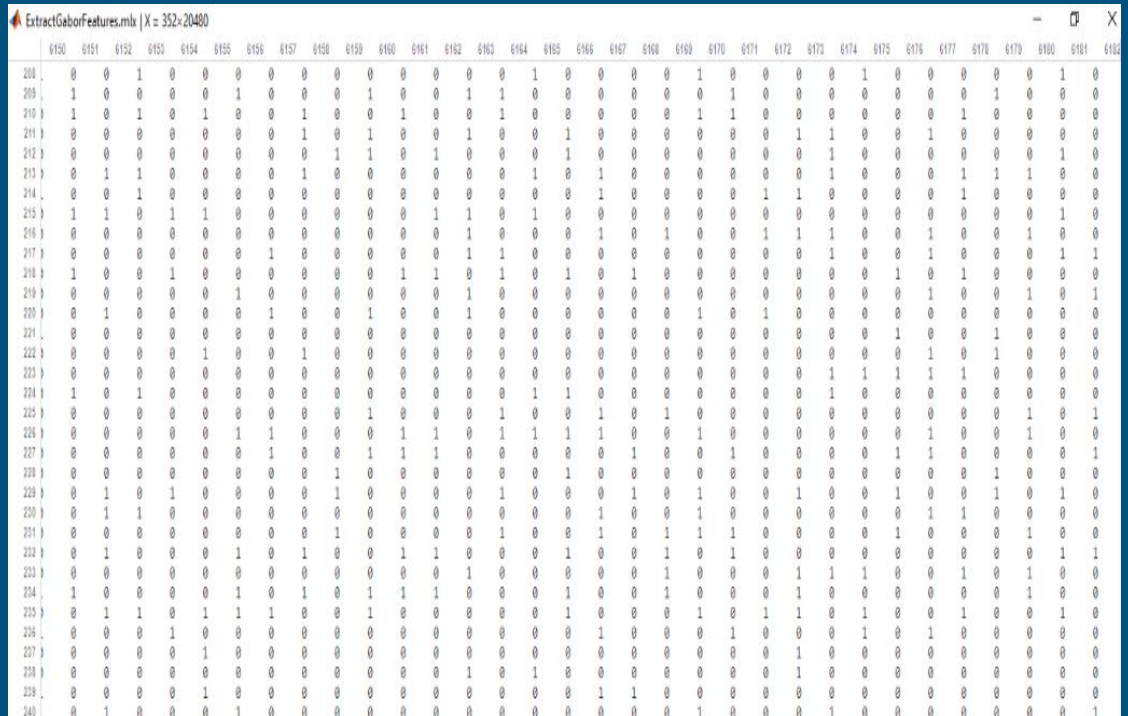
```
Mdl =
  ClassificationECOC
             ResponseName: 'Y'
    CategoricalPredictors: []
              ClassNames: [1 2 3 4 5 6 7 8 9 10 11 12 13 14
          ScoreTransform: 'none'
          BinaryLearners: {780×1 cell}
              CodingName: 'onevsone'


  Properties, Methods
```

Cross Validation

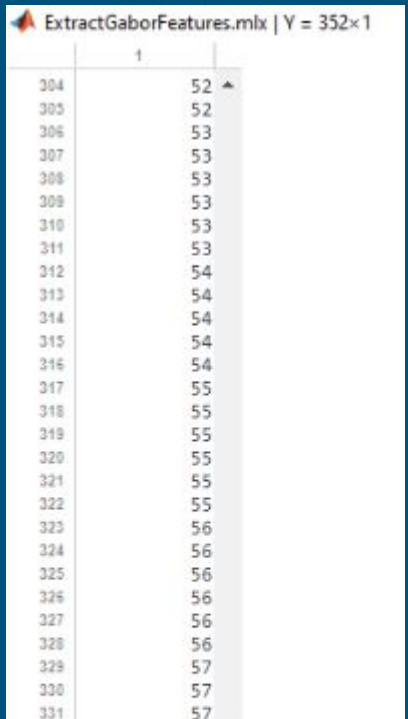
```
CVMdl =
  classreg.learning.partition.ClassificationPartitionedECOC
    CrossValidatedModel: 'ECOC'
         PredictorNames: {1×20480 cell}
           ResponseName: 'Y'
        NumObservations: 236
                  KFold: 4
              Partition: [1×1 cvpartition]
             ClassNames: [1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
         ScoreTransform: 'none'


  Properties, Methods
```

Results

X= 352x20480



Y=352x1



Problem Faced

1. Not able to use a set of Gabor Filters for feature extraction. This is due to the fact that large feature vectors were computationally time consuming for a 8GB Laptop. Therefore, only one Gabor Filter was used.
2. Lack of information about SVM Classification in paper.
3. According to the proposed method, there were 100 classes each having 6 palmprint images, where 3*100 images were used for training and remaining 300 for testing. We implemented this but our K-Fold generalization error always turned out to be >80%.
4. We used **fitcecoc** model of MATLAB for multiclass SVM and tried to train the model with various parameters as mentioned below:
    a. Coding = `'allpairs'` and `'onevsone'`, `'binarycomplete'`, `'denserandom'`, `'onevsall'`, `'ordinal'`, `'sparserandom'`, `'ternarycomplete'`
    b. Learners = `'discriminant'`, `'kernel'`, `'knn'`, `'linear'`, `'naivebayes'`, `'svm'`, `'tree'`
    c. Crossval = `2,3,4,5,6,7,8,9,10`
    d. Used k-fold loss function to measure generalization error.

Improvised Solution

We employed Gabor filter for image enhancement and Harris Detector for detecting Lines and Edges in Palmprint ROI. We then extracted the features and used Docker for securing the palmprint features.

Conclusion

Competition code features of palmprint are extracted by Gabor filters. The extracted features of the competing code occupy a small space, and the extraction accuracy is high. Irreversible matrix is generated by general permutation matrix. The key space is large enough. The cancelable palmprint templates are produced by multiplying the irreversible matrix and the original palmprint feature. In this paper, the method based on matrix transformation can not only protect the original palmprint template, but also satisfies the recognition accuracy