

# A Comparative Study of Feature Selection in Face Recognition Using Harmony Search Algorithm and PCA

Aayushi Bansal

**Abstract**—Feature selection is a technique used to select most informative features from the training data set. In this paper, we studied a method for feature selection in face recognition on ORL face database using harmony search algorithm and compared it with popular Principal Component Analysis (PCA) for face recognition. The studied method consists of two steps, firstly feature extraction which is followed by feature selection. Results of the experiment reveal that the Harmony Search algorithm yields better results than PCA technique.

**Index Terms**—Feature Selection, Face Recognition, Harmony Search Algorithm, PCA.

## I. INTRODUCTION

Face recognition is a very interesting topic as it deals with security and privacy [3]. It is a computer based application which identifies and verifies a person's identity by individual digital images and ensures privacy by limiting the access to unauthorized data. Face image samples are high in dimension, so we reduce high dimensional image data to low dimension in order to reduce the memory space and computational complexities. To reduce the dimension, we perform dimensionality reduction which includes two steps; firstly feature extraction which is followed by feature selection [2]. For feature extraction, PCA (Principal Component Analysis) is used which is followed by a metaheuristic approach for feature selection. One such metaheuristic approach is harmony search algorithm which is briefly described in section 3 of this paper. Two experiments are performed, one deals with PCA technique alone and another is a combination of PCA and Harmony Search Algorithm. Results are noted for different eigenvalues and represented in a form of graph with the comparison between two techniques as shown in section 4 of this paper.

PCA is a useful statistical technique used for feature extraction. It has found applications in fields such as face recognition and image compression, as it is a technique used for finding patterns in high dimensional data. It is used to identify patterns in data, and express the data and highlight their similarities and differences.

Harmonic search algorithm is a metaheuristic algorithm used for feature selection. HSA is used to select a subset of features from

the high dimensional image data to give better results in face recognition. A set of images has been taken for six faces combination and the Harmony search algorithm with PCA is applied on it and further was compared with a PCA technique used alone and proved to give better results than PCA [9]. Fig. 1 shows the flowchart of the basic HS-based feature selection algorithm.

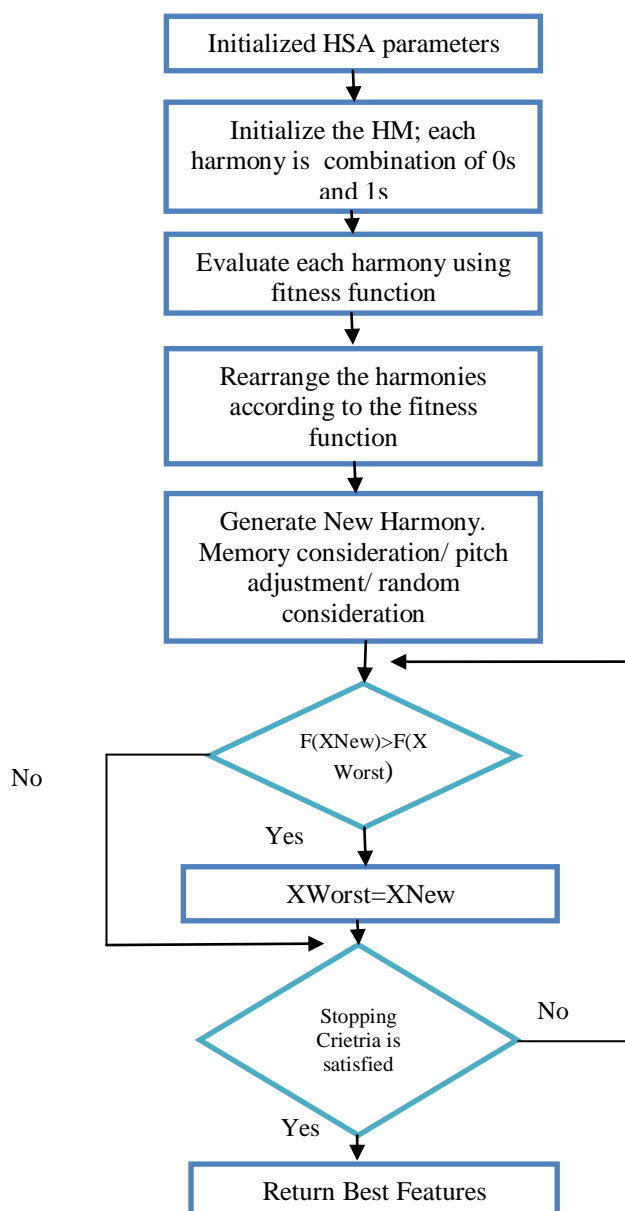


Fig. 1: Flowchart of the basic HS-based feature selection algorithm.

II. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this paper, six faces databases, created using randomization of ORL face database in such a way that training and testing images are not overlapped, have been used for experimentation. The experiment was performed by combination of PCA and Harmony search algorithm for three different cases. First case consists of five training images and five test set images, second dataset consists of six training and four test set images, third dataset consists of four training and six test set images. Each dataset is experimented over four classes i.e. 10, 20, 30 and 40. Then results (recognition rate vs number of features) are taken by averaging best feature set for all six faces for respective classes in all three cases. Second experimentation was performed by using PCA on the above database.

**Experiment 1:** The first experiment was performed to find the best feature set corresponding to 10, 20, 30 and 40 classes having training and testing image set of 50, 100, 150 and 200 images respectively. Results have been shown as Fig. 2, 3, 4, 5 via graphs and it reveals that the combination yields better results than the PCA alone.

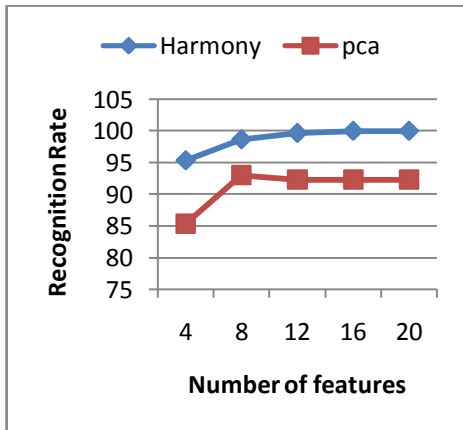


Fig.2:Class 10

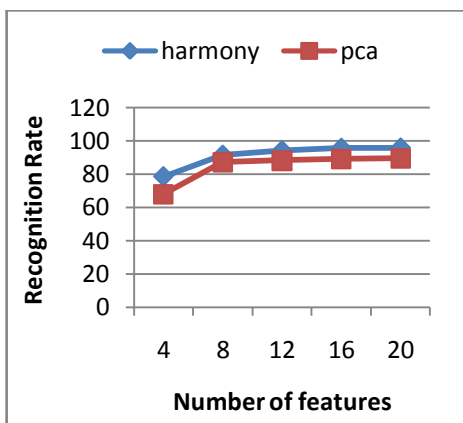


Fig.3:Class 20

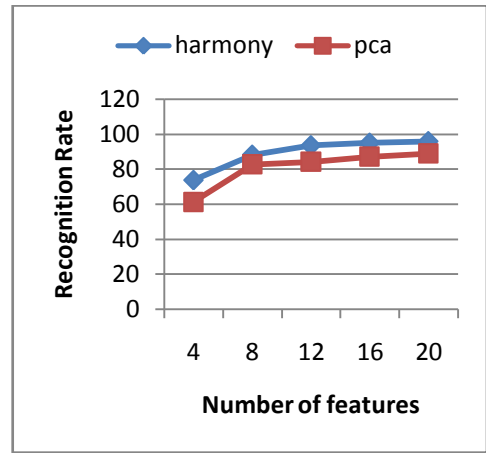


Fig.4: Class 30

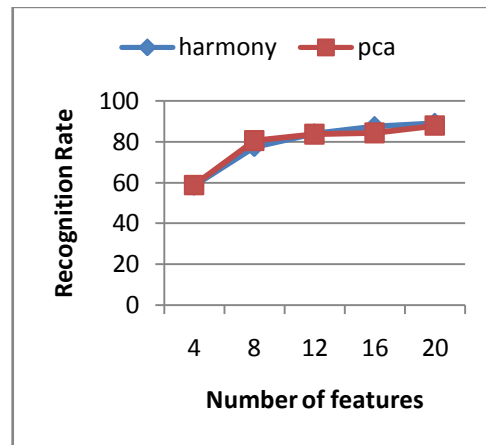


Fig. 5:Class 40

**Experiment 2:** The second experiment was performed to find the best feature set corresponding to 10, 20, 30 and 40 classes having 6 training images and 4 test images set. Results have been shown as Fig. 6, 7, 8, 9 via graphs and it reveals that the combination yields better results than the PCA alone.

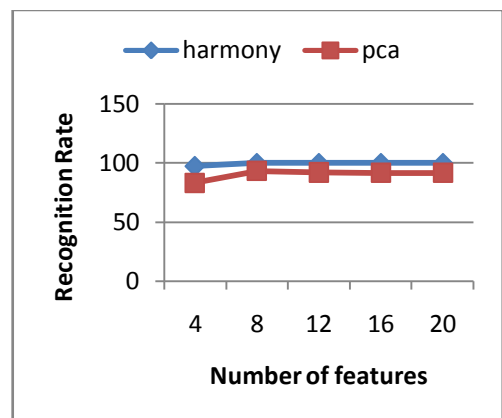


Fig.6:Class 10

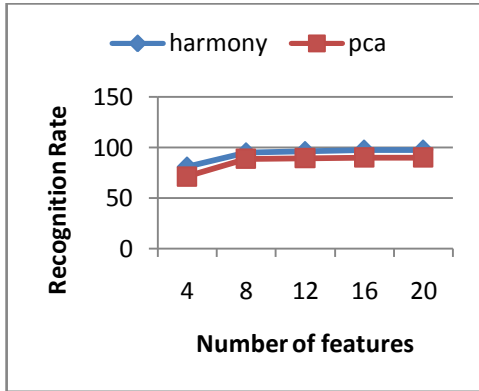


Fig.7:Class 20

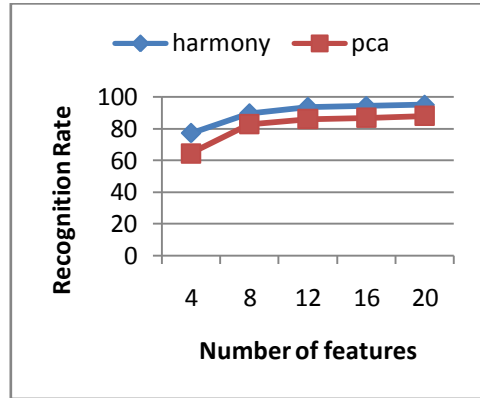


Fig. 11:Class 20

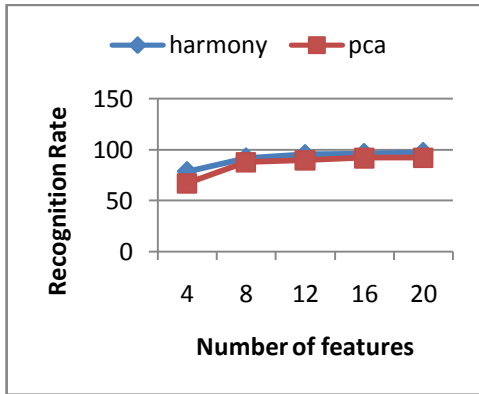


Fig.8: Class 30

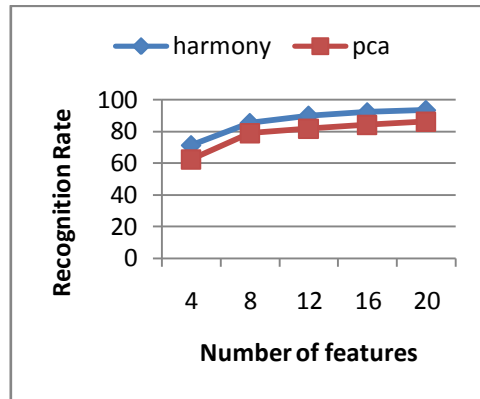


Fig. 12: Class 30

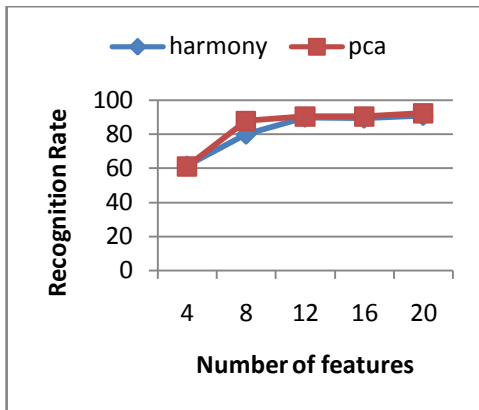


Fig. 9:Class 40

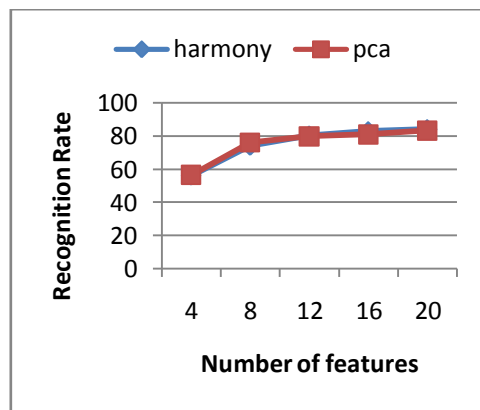


Fig. 13:Class 40

**Experiment 3:** The third experiment was performed to find the best feature set corresponding to 10, 20, 30 and 40 classes having 4 training images and 6 test images set. Results have been shown as Fig. 10, 11, 12, 13 via graphs and it reveals that the combination yields better results than the PCA alone.

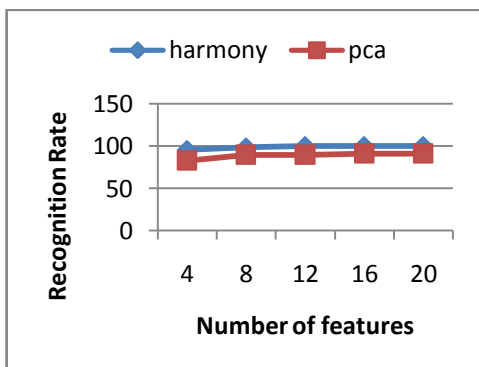


Fig. 10: Class 10

Results depicts that the combination of PCA and Harmony search method yields better results than the PCA method alone and it is also noted that the recognition rate increases with the number of training images as the number of eigenvectors increases. In each case results are noted for each of six faces and the final result is evaluated by averaging the value (recognition rate) corresponding to best feature set from all six faces and represented in the form of graph in order to clearly illustrate the comparison between the two methods.

### III. CONCLUSION

In this paper, Harmony Search based feature selection in face recognition has been studied and compared with PCA. Compared algorithm is a combination of feature extraction and selection which includes PCA and Harmony search algorithm. Combination method results are compared with that of PCA and then the results demonstrate that the combination method yields better performance than the PCA method alone. It is observed that the recognition rate

increases with the number of training images and decreases with the increase in number of classes.

## REFERENCES

- [1] X Wang, J Yang, X Teng, R Jensen, "Feature Selection based on Rough Sets and Particle Swarm Optimization", *Pattern Recognition Letters, Elsevier*, Volume 28, Issue 4, pp 459-471, 1 March 2007.
- [2] Dinesh Kumar, Shrutika, "Harmony Search Algorithm for Feature Selection in Face Recognition", *Computational Intelligence and Information Technology, Springer*, pp 385-390, 2011.
- [3] Dinesh Kumar, Shakti Kumar, C. S. Rai, "Feature selection for face recognition: a memetic algorithmic approach", *Journal of Zhejiang University SCIENCE A, Springer*, Volume 10, Issue 8, pp 1140-1152, August 2009.
- [4] M S Lotfabad, A M E Moghadam, "The Comparison of Different Feature Decreasing Methods Base on Rough Sets and Principal Component Analysis for Extraction of Valuable Features and Data Classifying Accuracy Increasing", *International Conference on Integrated Intelligent Computing*, pp 108-113, 2010.
- [5] Dinesh Kumar, C. S. Rai, Shakti Kumar, "Principal Component Analysis for Data Compression and Face Recognition", *INFOCOMP Journal of Computer Science*, volume 7, Number 4, pp 48-59, December 2008.
- [6] Mamta Dhanda, "Face Recognition Using Eigenvectors From Principal Component Analysis", *International Journal of Advanced Engineering Research and Studies*, Volume 1, Issue 2, pp 37-39, March 2012.
- [7] Abhishek Banerjee, "Impact of Principal Component Analysis in the Application of Image Processing", *International Journal of Advanced Research in Computer Science and Software Engineering*, Volume 2, Issue 1, January 2012.
- [8] P Chakraborty, G Roy, S Das, D Jain, A Abraham, "An Improved Harmony Search Algorithm with Differential Mutation Operator", *Fundamenta Informaticae- Swarm Intelligence*, Volume 95 Issue 4, pp 401-426, December 2009.
- [9] Rana Sawalha, Iyad Abu Doush, "Face Recognition Using Harmony Search-Based Selected Features", *International Journal of Hybrid Information Technology*, Volume 5, Number 2, pp 1-13, April 2012.
- [10] WANG, XIAOLIE, GAO, XIAO-ZHI, ZENGER, KAI, "THE OVERVIEW OF HARMONY SEARCH", *CHAPTER 2, AN INTRODUCTION TO HARMONY SEARCH OPTIMIZATION METHOD, SPRINGER*, pp 5-11, 2015.
- [11] Zaid Abdi Alkareem Alyasseri, "Face Recognition using Independent Component Analysis Algorithm", *International Journal of Computer Applications*, Volume 126, Number 3, pp 34-38, September 2015.
- [12] Allen Y. Yang, John Wright, Yi Ma, S. Shankar Sastry, "Feature Selection in Face Recognition: A Sparse Representation Perspective", *IEEE TRANS. PAMI*, pp 1-34, August 2007.
- [13] Manisha Satone, Gajanan Kharate, "Feature Selection Using Genetic Algorithm for Face Recognition Based on PCA, Wavelet and SVM", *International Journal on Electrical Engineering and Informatics*, Volume 6, Number 1, pp 39-52, March 2014.
- [14] S. Thakur, J. K. Sing, D. K. Basu, M. Nasipuri, M. Kundu, "Face Recognition using Principal Component Analysis and RBF Neural Networks", *International Journal of Simulation: Systems, Science and Technology*, Volume 10, Number 5, pp 7-15, 2008.