

Data Dimension Reduction in Training Strategy for Face Recognition System

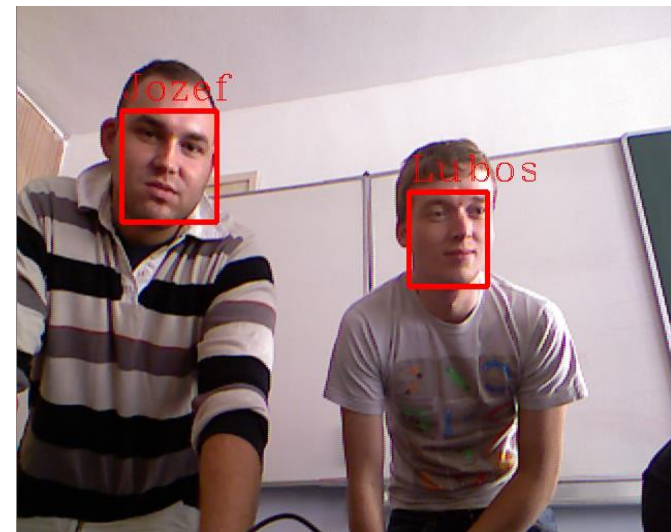
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Croatia

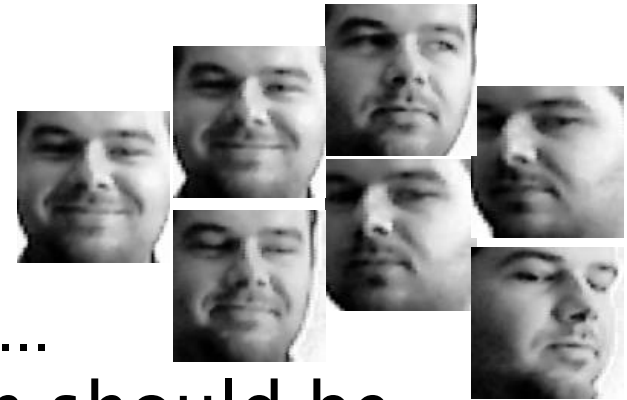
Motivation

- ▶ Face recognition system with continuous authentication
- ▶ Real time face detection, tracking and recognition
- ▶ Kinect as input sensor



Motivation

- ▶ Which images should be used in training process?
 - Kinect 30 fps
 - 300 frames per 10 second
 - Selection fully automated
 - SOM, DBSCAN, K-means, Random, ...
- ▶ What kind of feature extraction should be used?
 - PCA, LDA, LBP, LBP+PCA
- ▶ What in the case of adding a new user or removal known user?



Input Data

- ▶ CMU PIE face database
 - Collected at Carnegie Mellon University
 - Pose (13 different)
 - Illumination (43 different)
 - Expression (4 different)
 - 68 individuals



Selected images

- ▶ 3 different poses
- ▶ Grey scale images
- ▶ 64x64 pixels
- ▶ 97 images per subject
- ▶ Pre-processing
 - Global histogram equalization
 - Contrast-limited adaptive histogram equalization (CLAHE)

C05



C27



C29



Feature extraction

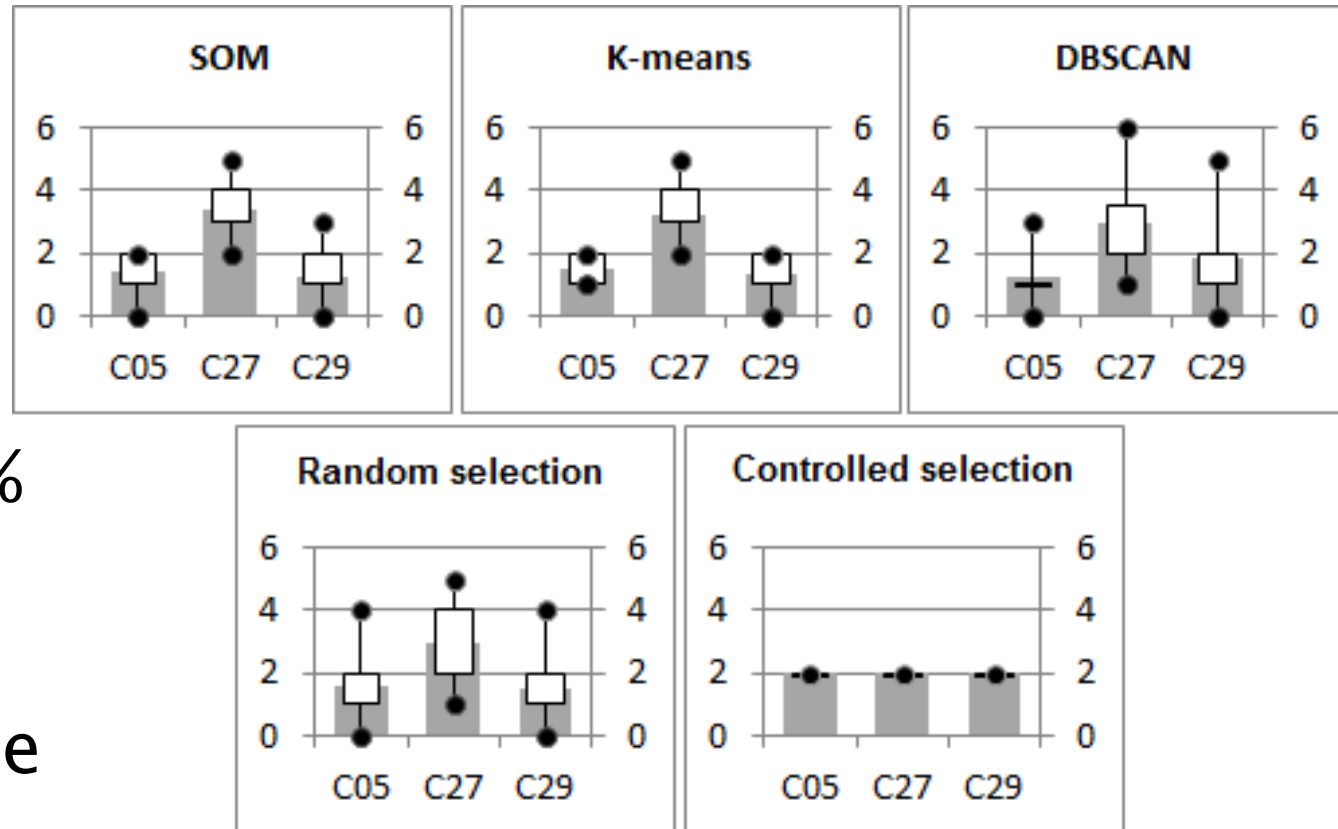
- ▶ Principal Component Analysis – PCA
 - An orthogonal linear transformation, eigenfaces
- ▶ Linear Discriminant Analysis – LDA
 - It maximizes between-class and minimize within-class variance, fisherfaces
- ▶ Local Binary Patterns – LBP
 - Texture descriptor
- ▶ Combination of LBP and PCA

Clustering algorithms

- ▶ Self-organizing map – SOM
 - A neural network utilizes a topographic map
- ▶ K-means
 - It minimizes the sum of point-to-cluster-centroid distances over all k clusters
- ▶ Density-based spatial clustering of applications with noise – DBSCAN
 - It utilizes points' neighbourhood and connection between them
- ▶ Random selection
 - Totally random selection
- ▶ Partially controlled selection
 - Random selection according to three different poses

Training images

- ▶ **Bullet** – minimum, maximum
- ▶ **White bar** – 25% and 75% percentile
- ▶ **Solid (grey) bar** – average



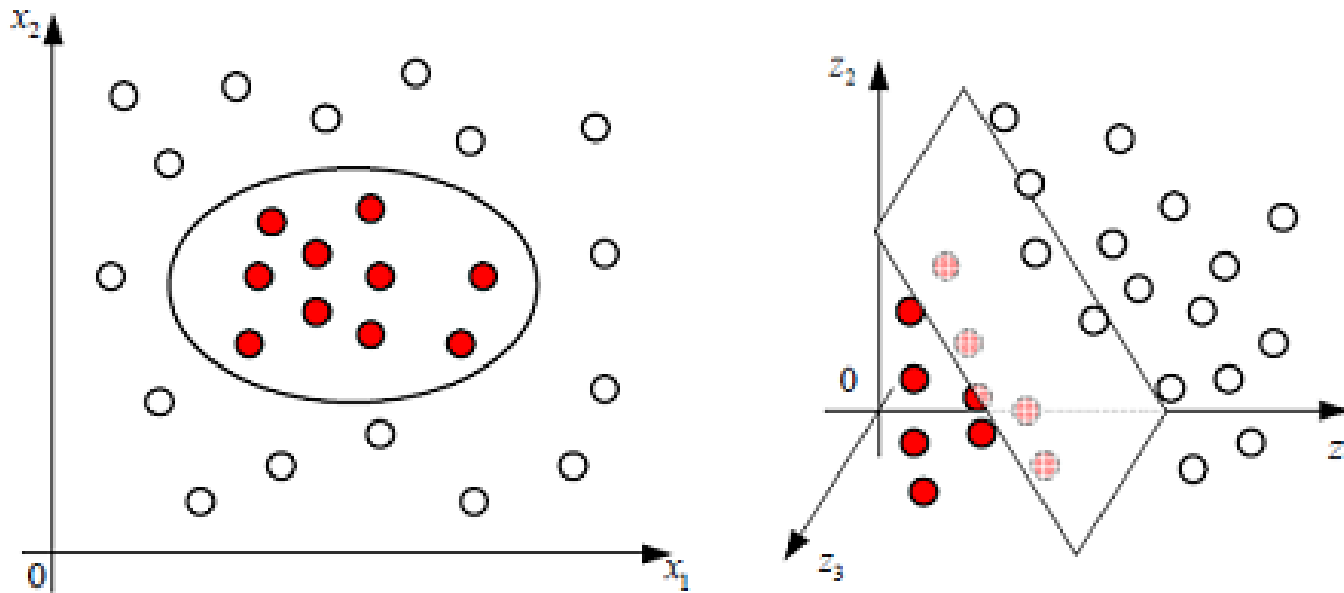
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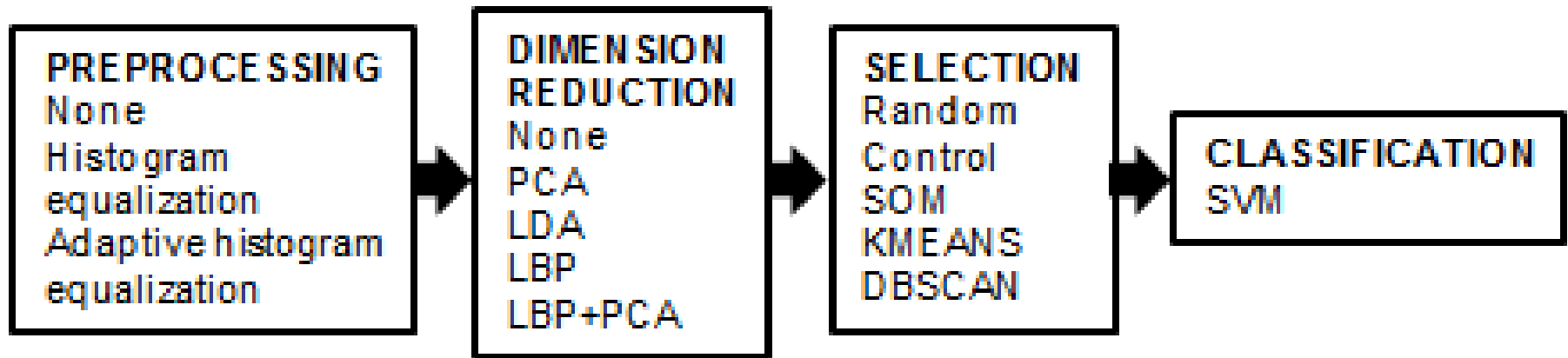
Feature classification

- ▶ Support Vector Machine – SVM
 - Projection axis that maximize the margin criterion
 - Gaussian radial basis functions

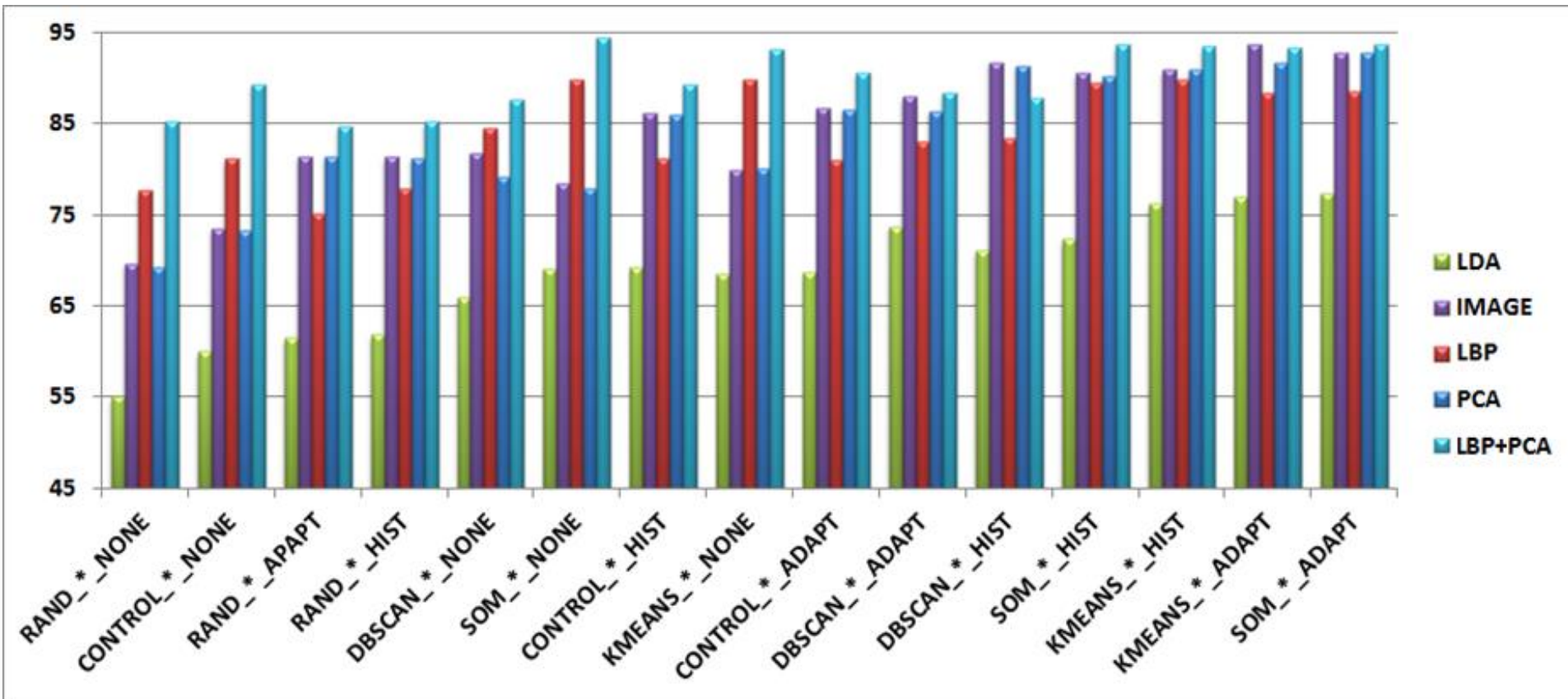


Proposed Methodology


- 68 subj. x 6 images = 408 training samples
- 68 subj. x 91 images = 6188 testing samples



Experimental Results



Conclusion

- ▶ Non-equal number of training samples per pose
 - ▶ DBSCAN did not achieve desired performance
 - ▶ It is necessary to store all training images in the case of using PCA or LDA
 - ▶ 354 PCA features achieved the same recognition accuracy as well as original images (4096 features)
 - ▶ It is not necessary to store original training images in the case of using LBP
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Conclusion

- ▶ Pre-processing
 - None
- ▶ Feature extraction
 - LBP and PCA, respectively
 - $P = 8, R = 2$
 - LBP histogram with 1180 features
 - Blocks created according to rows of binary image
 - PCA with 354 features
 - 94,473% recognition accuracy
- ▶ Training samples selection
 - SOM or K-means
 - Number of neurons = 6 (SOM)
 - Parameter $k = 6$ (K-means)

Future work

- ▶ Unknown user problem (open space)