Local methods

- Local feature based methods
  - EBGM
- Local Appearance-based methods
  - Probabilistic approach
  - SoM Face
  - Modular FLDA
  - Component LDA
  - LBP

Local methods

Local Feature based method

→ Detects local features first then extract features on located feature points

Local appearance based method

→ Partition the face images into sub regions

→ extract local features in ~~Partition~~. Partition.

Local feature based Method

Early methods used
↳ geometric features.

Disadvantage

↳ Hard to extract in some case.

→ Alone, not enough → as it ignores gray level values.

Paper

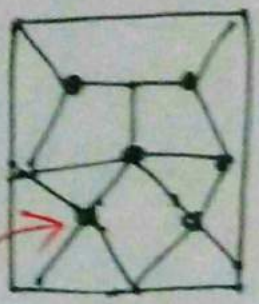
facial feature detection & Representation Based on Gabor wavelet Decomposition.

↳ similarity → checked by Graph matching

Drawback :- Assume fix-topology Graph. → once it get fixed → no modifications allowed.

Deformable Topology Graph Matching

→ Elastic Bunch Graph Matching (EBGM)



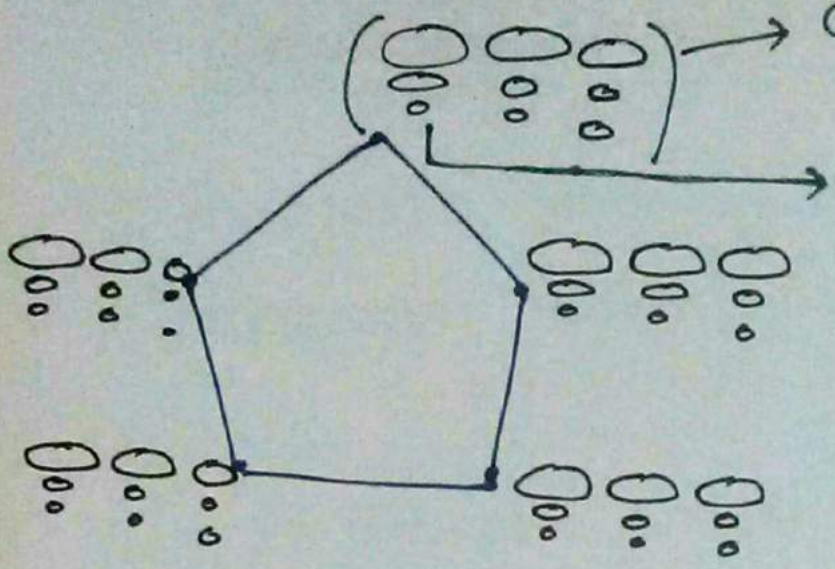
→ Topology → Graph image is constructed first for each face image.

each feature point is located manually & Gabor → Jet

↑ 40 Dimensional feature Vector is computed using Wavelet Transform.

→ Wavelet Coefficients
40 → 8 Direction
→ 5 frequencies.

→ edge weight → Distance between feature point.



→ Gabor jets

e.g. eye feature
Diff. sets of Gabor jets for eye → (open, close, diff. Pose & angle) are stored.

→ For new image →
manually select features
→ find jets → Compare with each set of jets.

(Gabor jets) → 40 features → Directions
→ frequencies

↳ Robust against
↳ illumination
→ Distortion
→ Scaling.

Disadvantages
=
→ More computational Efforts than other methods
→ Difficult to implement in Practice.

Local feature Point based method

↳ Disadvantages

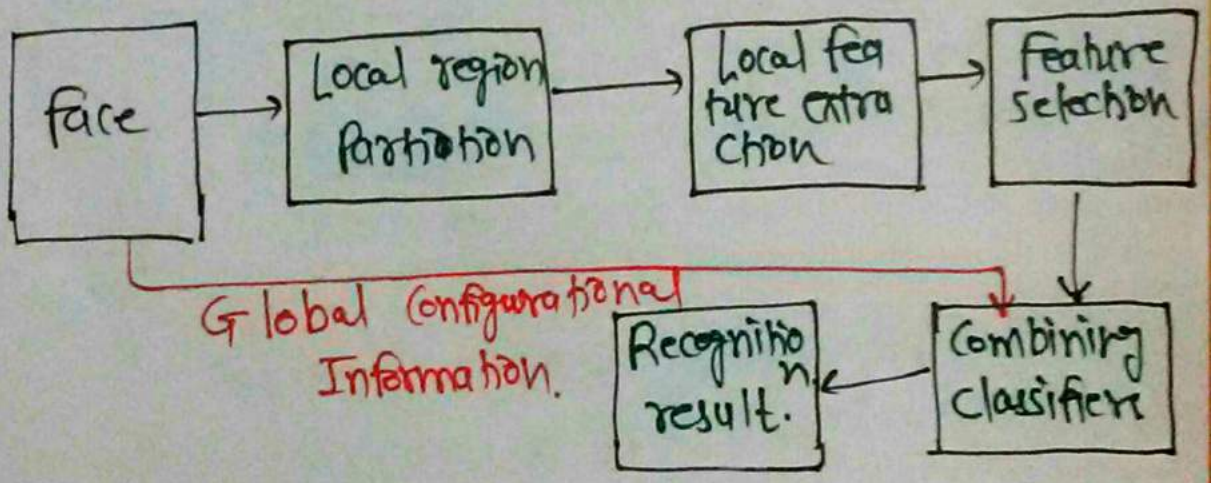
↳ over-illumination → reflection on face skin

→ Screaming.

Solution

Local Appearance Based Method

Accurate localization of feature points → not needed.



Local Probabilistic Approach

→ Recognize partially occluded and Expression Variant face from single sample per class

1→ Generate virtual samples by image perturbation method.

2→ Divide each face into six ellipse-shaped local areas.

3→ All local patches at the same-position of each face are grouped-subspace → Total 6 subspaces

4→ Transform each face subspace into eigenspace.

5→ Test images is also divided into six local areas & Projected onto - an above eigenspace.

→ Disadvantage :- Storage & Computational cost

Solution :→ Self Organizing Maps

Self-Organizing Maps

→ Neural network algorithm using unsupervised competitive learning.

→ Primarily used for organization and visualization of complex data.

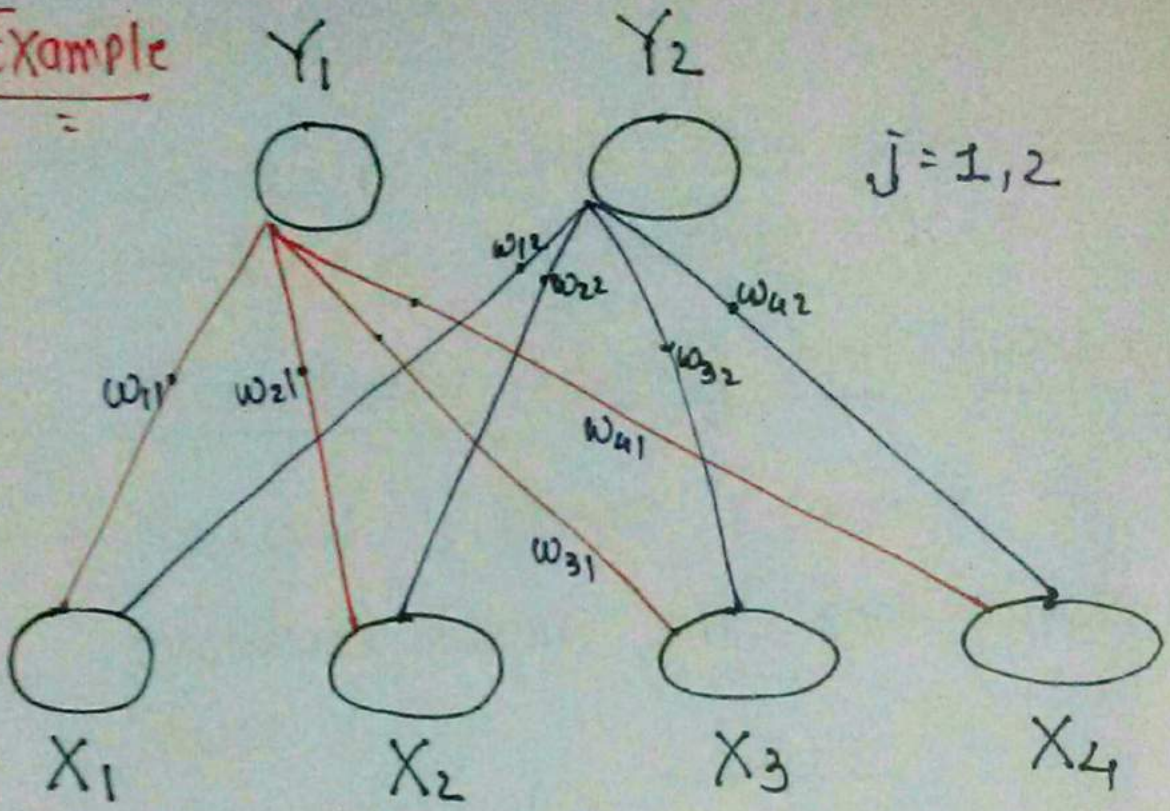
→ Neurons are arranged on flat grid.

→ There is no hidden layer. only input & output layer.

→ Each neuron on the grid is an output neuron.

→ Topological relationships within the training set are maintained.

Example



$i = 1, 2, 3, 4$

X_1, X_2, X_3 & X_4 → inputs

Y_1, Y_2 → outputs → two neurons

→ The structure is similar to Complete Bipartite Graph.

↳ every neuron is connected to each input.

SOM - Steps

→ Initialize weights, set neighbourhood radius → R, set learning rate α.

Repeat the following until → convergence

→ For each j neuron, → compute the Euclidean distance with each input Vector X_i

$$D(j) = \sqrt{\sum_{i=1}^{n} (X_i - w_{ij})^2}$$

→ Find the index J such that → D(j) is a minimum.

→ For all neurons j within a specified neighbourhood of J and for all i

$$W_{ij}(new) = w_{ij}(old) + \alpha(X_i - w_{ij}(old))$$

→ Update learning rate, Reduce radius, R, Test Stopping Condition.

SOM Face :-

→ Represent face subspace with self organizing maps

→ Each image → is partitioned into M → local sub-blocks.

→ Train SOM network for all obtained sub-blocks, from all training images. irrespective of classes.

→ Each subblock Ri → of same face image I are mapped into its → corresponding Best Matching-Units by. NN.

→ All the location Vectors of same face → grouped as set.

$$l = \{l_i\}_{i=1}^{M} = \{x_i, y_i\}_{i=1}^{M}$$

Face SOM Representation

Advantages

→ Robust to noise.

→ Compact face representation

Disadvantages

→ Require large quantity of good quality + representative training data.

Modular FLDA

Face Partition

→ all partitions → Combined → to act as images of one class → (Subimages)

→ Apply LDA on Subimages

↳ 86% recognition accuracy achieved.

Component LDA

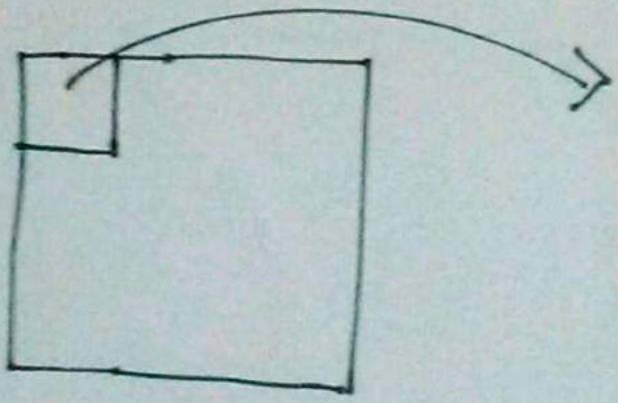
→ Similar to spatial Perturbation except → some parts such as mouth or eyes are perturbed.

↳ This way, number of training samples can be increased.

Local Binary Pattern

(LBP)

→ Visual Descriptor used for classification in Computer Vision.



47	51	65
62	70	70
80	83	78

→

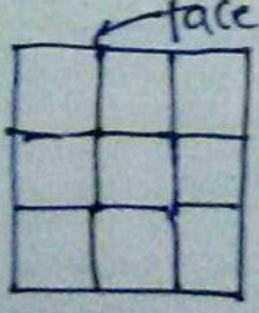
0	0	0
0		1
1	1	1

3X3 → Sample → Threshold

$1\times2^0+1\times2^1+1\times2^2+1\times2^3+$
$0\times2^4+0\times2^5+0\times2^6+0\times2^7=15$

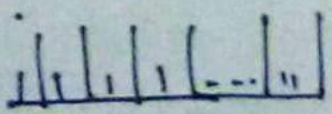
Value of LBP at (x_c, y_c) → $LBP_{P,R} = \sum_{P=0}^{P-1} s(g_p - g_c)2^p$

$s(x) = 1$ if $x \geq 0$
$= 0$, otherwise



face partition

→ Combine LBP Histograms of all partitions

↳  → feature

Disadvantages of Local Methods

Most methods are robust against some variation but not against other.

EBGM → Robust against
- ✓ → Expression
- ✓ → Illumination
- ✓ → Pose
- X → occlusion

SOM →
- ✓ occlusion
- X → Pose

Solution

Hybrid Method

↳ use of both, holistic & local information → may improve the capability of classifier.