

Partial Faces for Face Recognition

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Outline

- Objective
- Problem Definition
- Difficulties
- Recognition Architecture
- Database Acquisition
- Experiments
- Discussion

Objective

- To investigate if partial faces could be used for recognition
- To establish how much of a partial face is sufficient for recognition

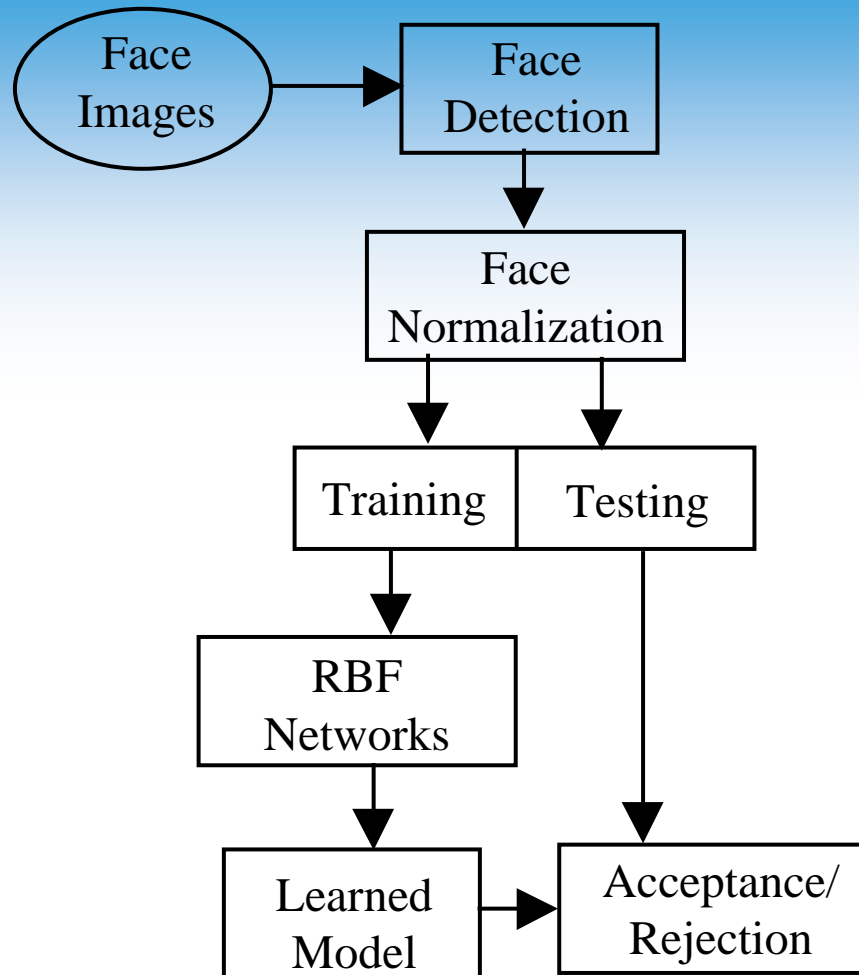
Problem Definition

- *MATCH / IDENTIFICATION* - An image of an unknown individual is collected (“probe”) and the identity is found searching a large set of images (gallery). Matching becomes especially difficult when the probe is a duplicate rather than same (counterpart) image from the gallery
- *SURVEILLANCE / VERIFICATION* - The systems checks if a given probe belongs to a relatively small gallery labeled as a set of intruders. The system is usually flooded with thousands of faces (e.g. airport security)

Difficulties

- Geometry of image formation
- Photometry - illumination
- Individual characteristics - gender, race
- Changes in facial expression and aging
- Scale up and robustness

Recognition Architecture

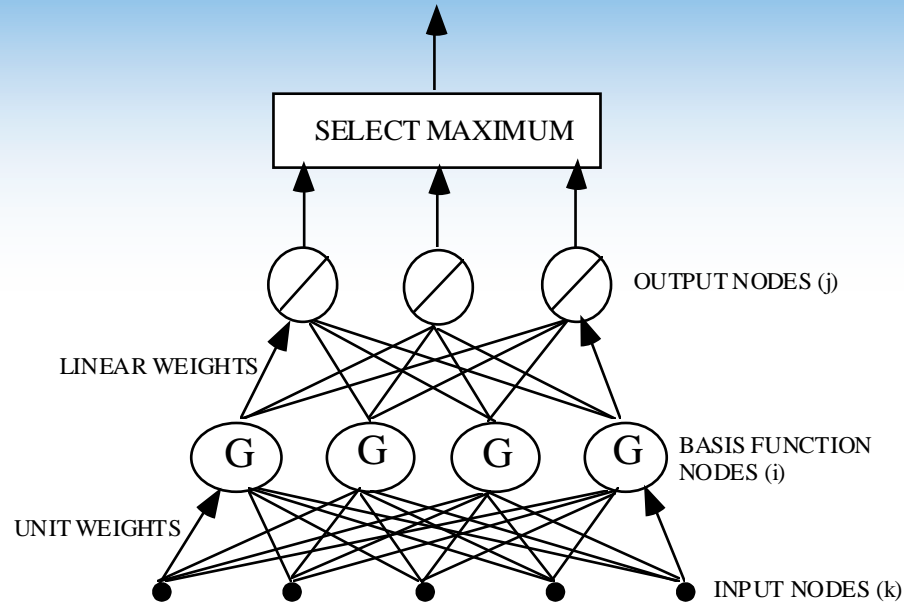


Recognition Architecture (cont.)

Srinivas Gutta and Harry Wechsler (1997), Face Recognition Using Hybrid Classifiers, *Pattern Recognition*, Vol. 30, No. 4

Recognition Architecture (cont.)

■ Radial Basis Function (RBF) Networks



Basis Function:

$$y_i = \Phi_i(\|X - \mu_i\|) = \exp\left[-\sum_{k=1}^D \frac{(x_k - \mu_{ik})^2}{2h\sigma_{ik}^2}\right]$$

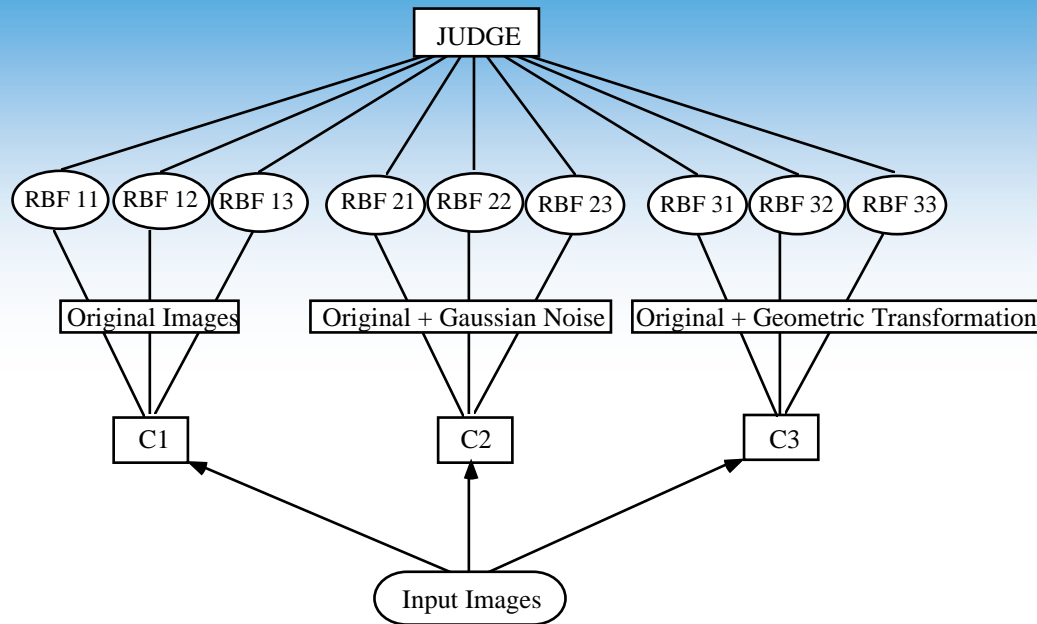
Activation of Output:

$$Z_j = \sum_i w_{ij} y_i + w_{0j}$$

Recognition Architecture (cont.)

- Ensembles of Radial Basis Function (ERBF) Networks
 - Different network topologies
 - Consensus ('averaging') and democracy ('majority') concepts
 - Training using both original and distorted data

Recognition Architecture (cont.)

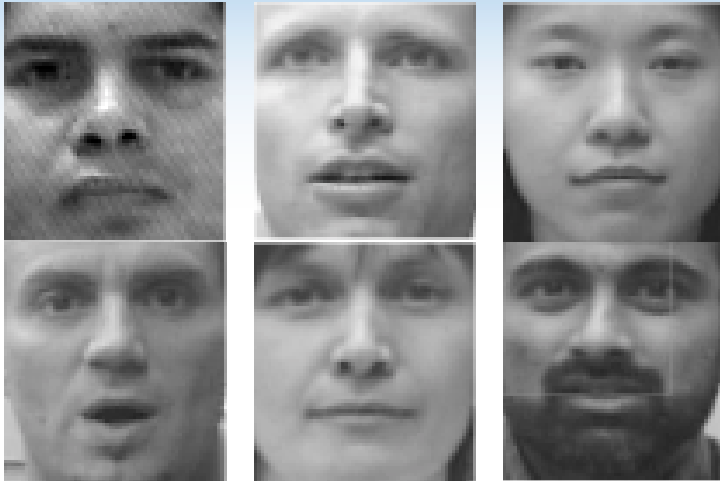


Judge for ERBF1: **If** the norm of the average of 5 of the 9 outputs is greater than threshold θ **then** accept ('recognize') **else** reject.

Database Acquisition

- 3000 normalized frontal images
- 150 subjects
- Resolution of images – 640x480 encoded in 256 gray scale levels
- Size of faces: 64x72 or 32x72

Database Acquisition



Let's make things better.



Experiments

- Experiment 1: Comparison of partial faces vs full face recognition while varying the number of images used for training
- Experiment 2: To assess recognition performance depending upon how much of partial face is used

Experiments – 1 (cont.)

- Training and Testing strategy: **k** - fold Cross Validation
- Total number of CV cycles: 20

<i>Partial Face Recognition Using RBF Network</i>	Accepted (correct) %	False Negative %	Rejected (Correct) %	False Positive %
1 Image per subject	77.67	22.33	79.33	20.67
5 Images per Subject	84.67	15.33	92.33	7.67
9 Images per Subject	91.33	8.67	95.33	4.67

Experiments – 1 (cont.)

<i>Partial Face Recognition Using Network Ensemble</i>	Accepted (correct) %	False Negative %	Rejected (Correct) %	False Positive %
1 Image per subject	85	15	87	13
5 Images per Subject	91	9	93	7
9 Images per Subject	96	4	97	3

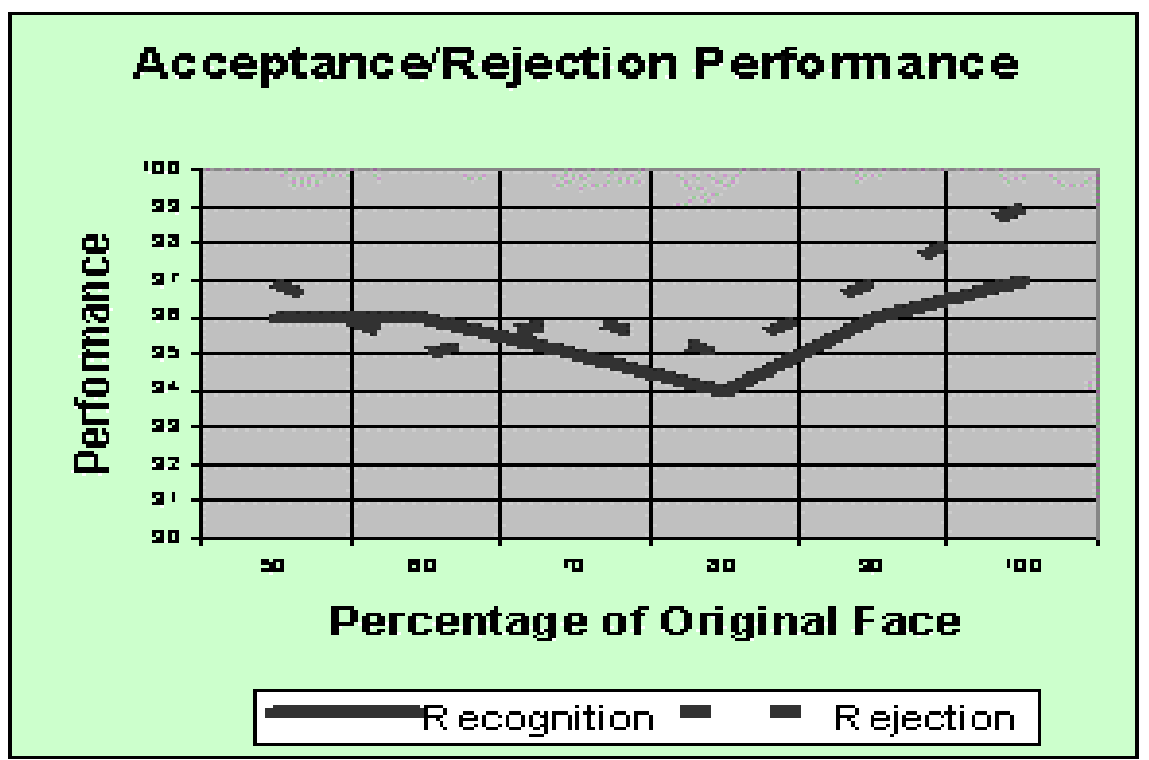
Experiments – 1 (cont.)

<i>Full Face Recognition Using RBF Network</i>	Accepted (correct) %	False Negative %	Rejected (Correct) %	False Positive %
1 Image per subject	89	11	91	9
5 Images per Subject	92	8	95	5
9 Images per Subject	96	4	96	4

Experiments – 1 (cont.)

<i>Full Face Recognition Using Network Ensemble</i>	Accepted (correct) %	False Negative %	Rejected (Correct) %	False Positive %
1 Image per subject	92	8	94	6
5 Images per Subject	95	5	96	4
9 Images per Subject	97	3	99	1

Experiments – 2



Discussion

- Partial faces are sufficient for face recognition as faces are primarily symmetric in nature
- There is not much improvement in performance as the amount of information in the partial face is increased