

# Short-Time and Long-Time Aging Analysis in Human Faces

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*Vision Lab*



# Outline



- Introduction
- Short-time analysis
  - Quantitative measure of face differences
  - Experimental evaluation
- Long-time analysis
  - Current status of long-time analysis
  - Delhi face aging database
  - Experimental evaluation
- Summary



# Outline

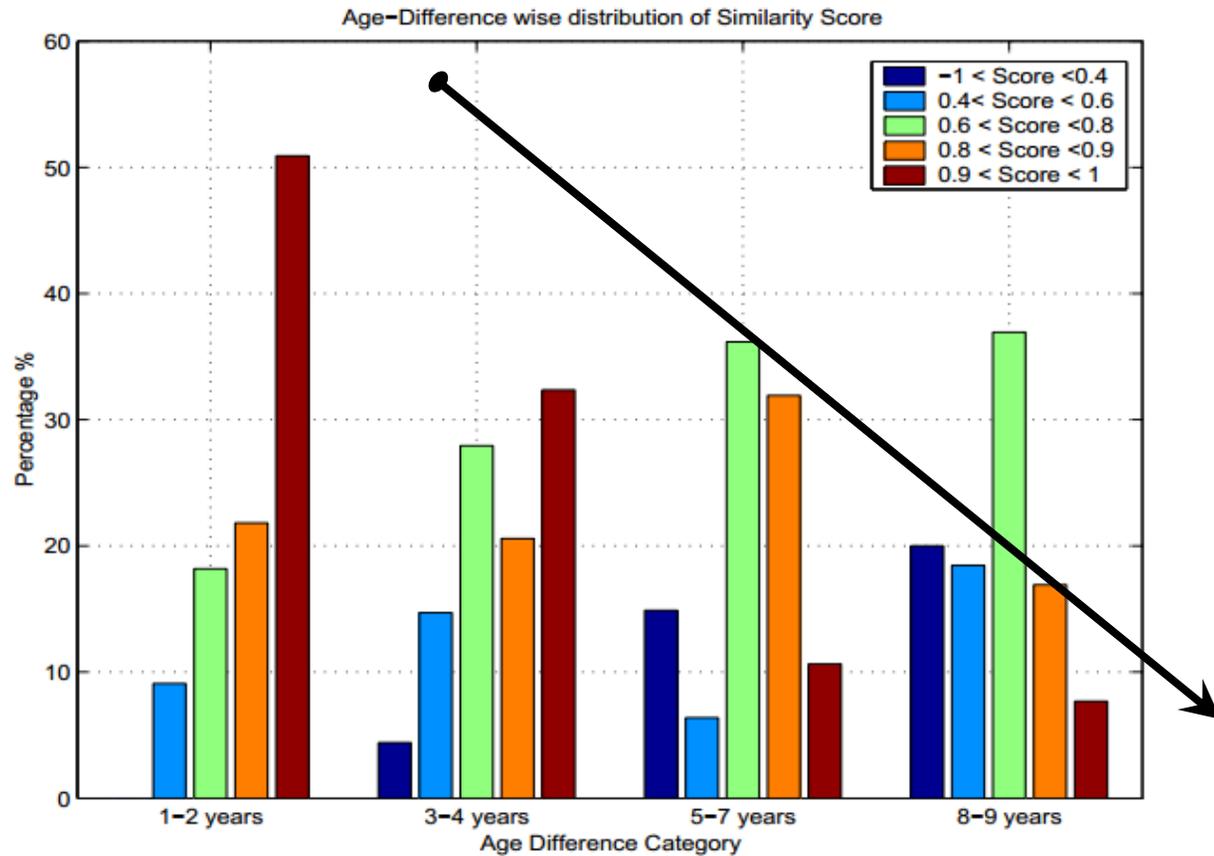
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# Aging analysis in human faces



- Aging effect in faces

Similarity scores decreased  
as age difference increases

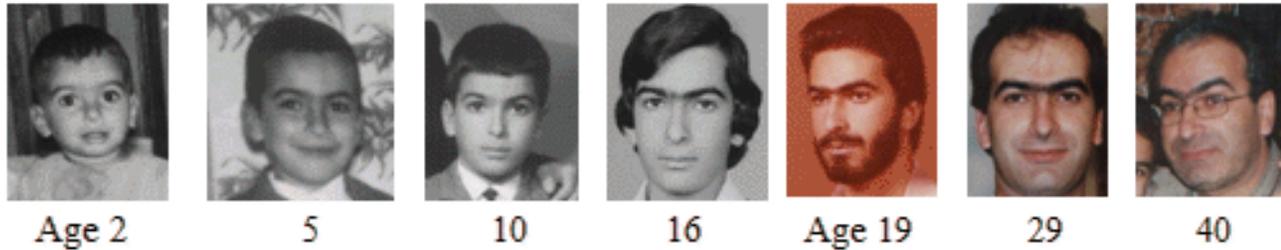


N. Ramanathan and R. Chellappa, "Face verification across age progression", IEEE TIP, 2006.

# Aging analysis in human faces



- Aging effect in faces



N. Ramanathan, R. Chellappa, and S. Biswas, “Age Progression in Human Faces: A Survey”, J. of Visual Languages and Computing, 2009.

**Formative years: shape variation**

**Later stages: texture variation**

H. Ling, S. Soatto, N. Ramanathan, and D. Jacobs, “A Study of Face Recognition as People Age”, ICCV 2007.

**Performance degradation is observed  
when matching age separated faces**

# Aging analysis in human faces



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- To design a robust face recognition algorithm, both quantitative evaluation of appearance changes and regular update of facial template are required.
- Long-time vs short-time

# Aging analysis in human faces



- To design a robust face recognition algorithm, there is a great demand for both quantitative evaluation of appearance changes and regular update of facial template
- Long-time vs short-time

***Living My  
Life Faster***

Oct 1 1998–2006

8 years of JK's  
Daily Photo Project





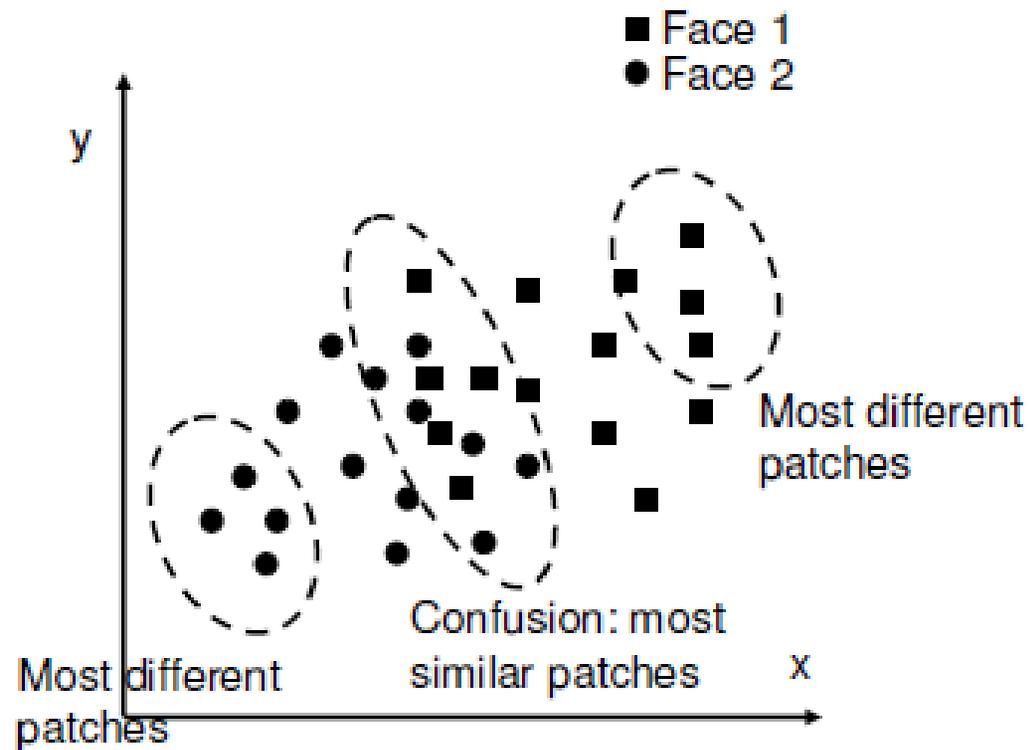
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# Quantitative measure of face differences



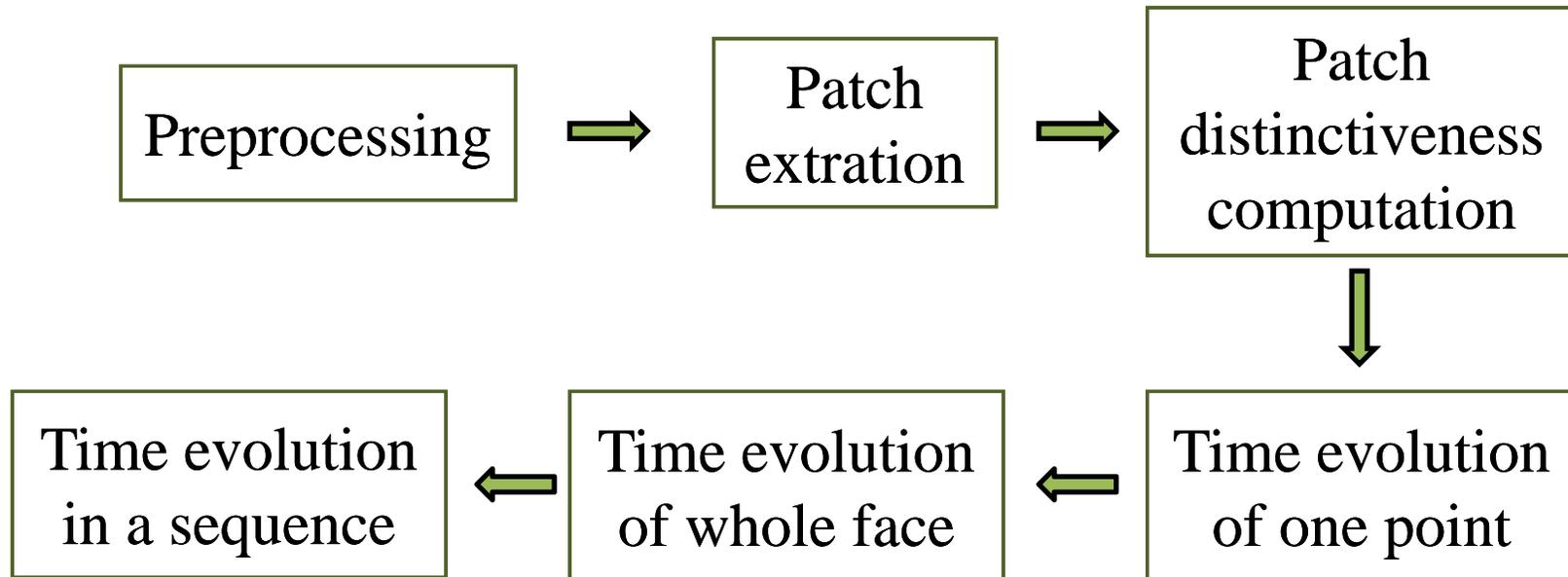
- Time evolution between faces
- Differences computation between faces



# Quantitative measure of face differences



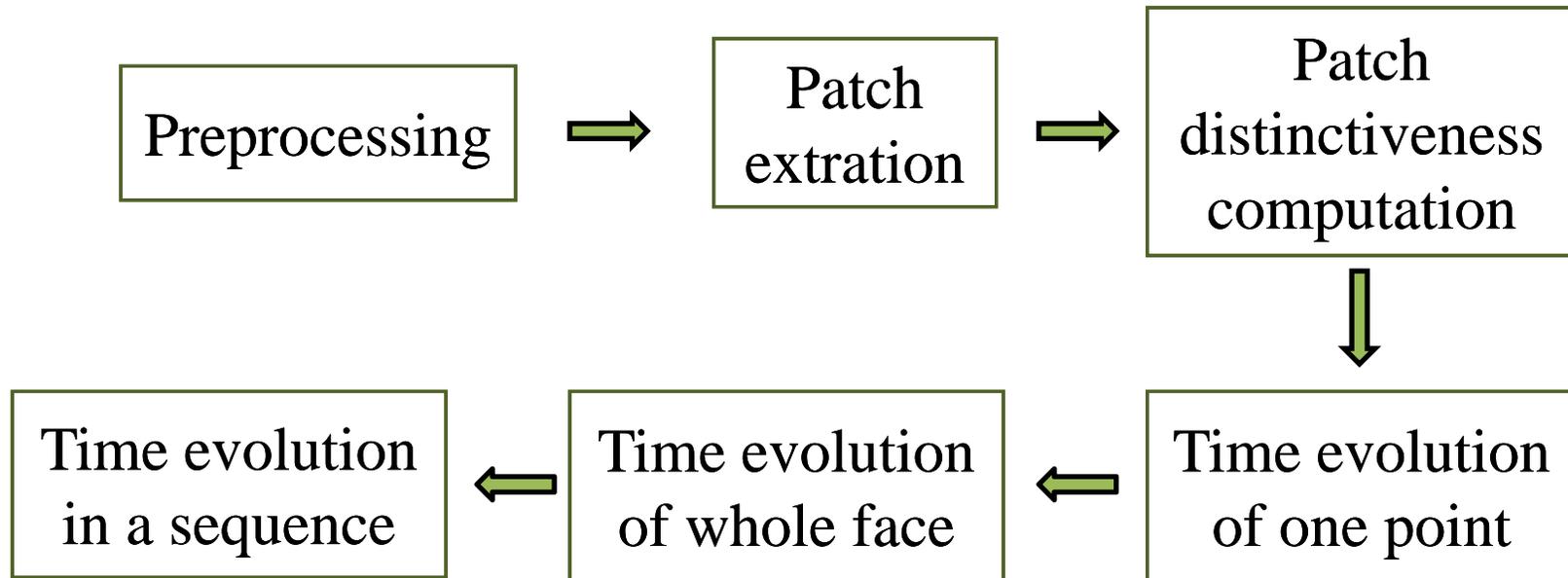
- How to compute the time evolution within a time span?



# Quantitative measure of face differences



- How to compute the time evolution within a time span?

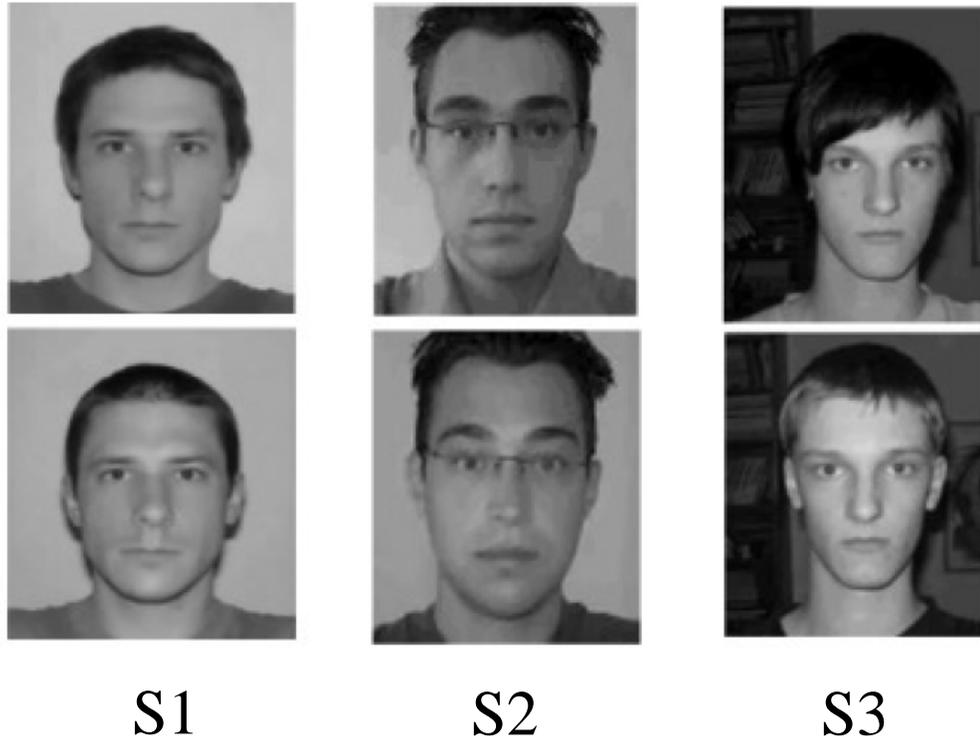


What does the global evolution of face appearance?

# Experimental evaluation



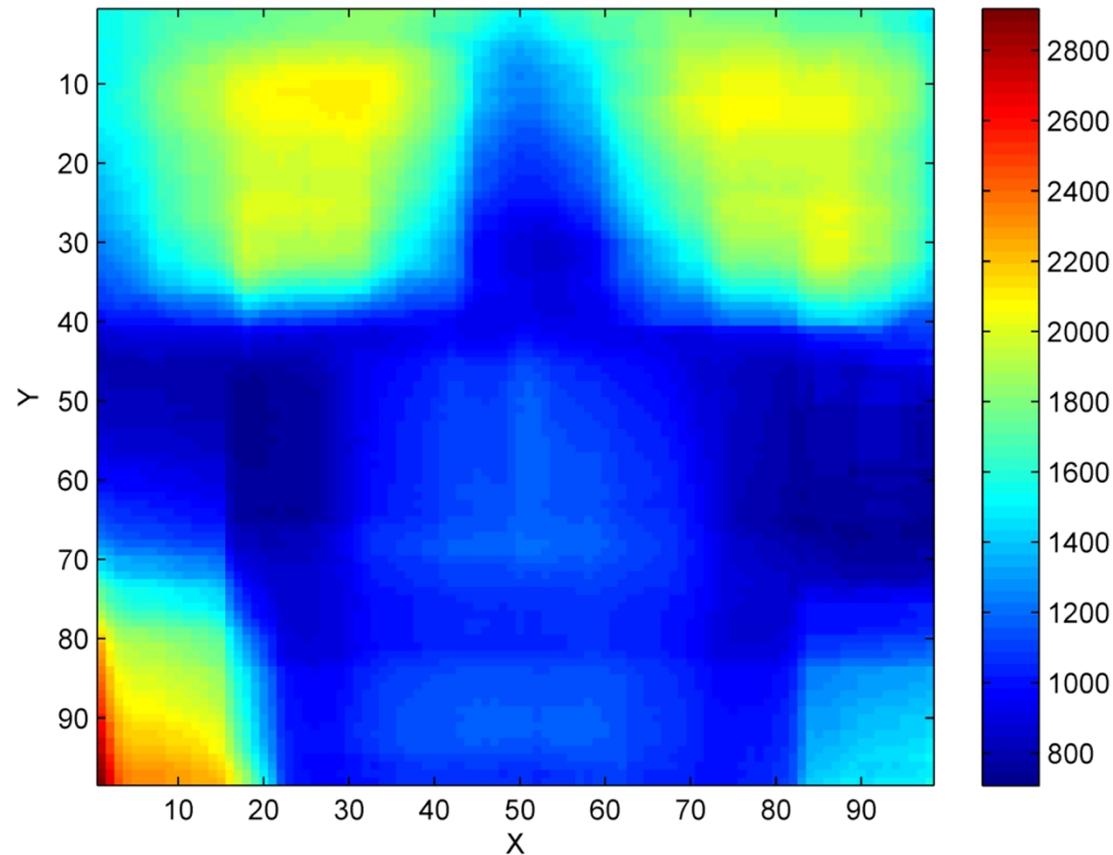
- Face dataset
  - Sequences of faces from publicly available videos.
  - Three sequences: S1 (4 years), S2 (3 years), S3 (1 year)



# Experimental evaluation



- Q1: global evolution of face appearance



The brighter the pixel, the faster the temporal evolution of the corresponding face point.



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# Current status of long-time analysis



- Well studied in human anatomy and visual perception
- Three active topics in aging analysis

- **Age estimation**

Y.H. Kwon and N. da Vitoria Lobo, "Age classification from facial images", Computer Vision and Image Understanding, 1999.

N. Ramanathan and R. Chellappa, "Face verification across age progression", IEEE TIP, 2006.

- **Computational models for age progression**

N. Ramanathan and R. Chellappa, "Modeling age progression in young faces", CVPR 2006.

N. Ramanathan and R. Chellappa, "Modeling shape and textural variations in aging adult faces", FG 2008.

- **Face recognition across age progression**

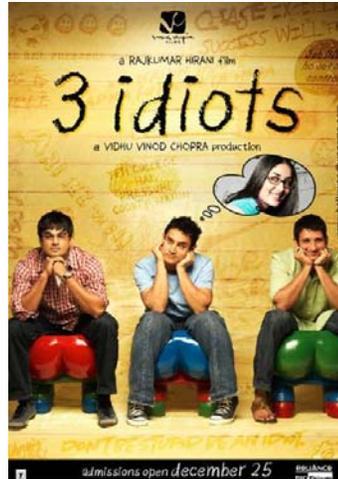
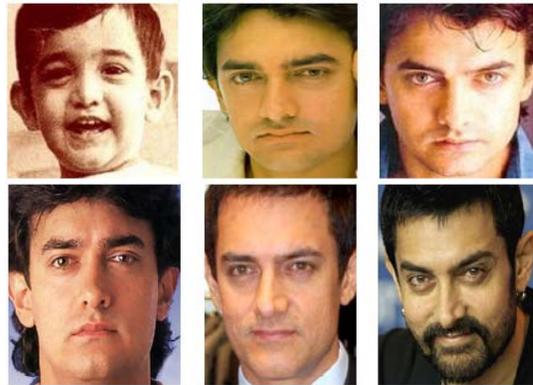
H. Ling, S. Soatto, N. Ramanathan, and D. Jacobs, "A study of face recognition as people age", CVPR 2007

# Delhi face aging database



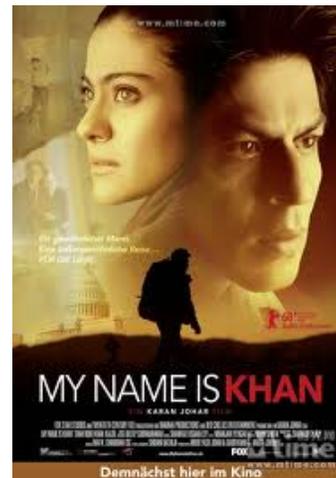
- Traditional face aging databases
  - FG-NET and MORPH
  - Acquired under very controlled conditions
- Delhi face aging database
  - Face images of celebrities collected in real-life scenarios
  - Real-life variations: makeup, pose, illumination, expression and resolution
  - Over 2,600 images from 49 female and 53 male Indian celebrities
  - Age span: between 4 and 88 years

# Delhi face aging database

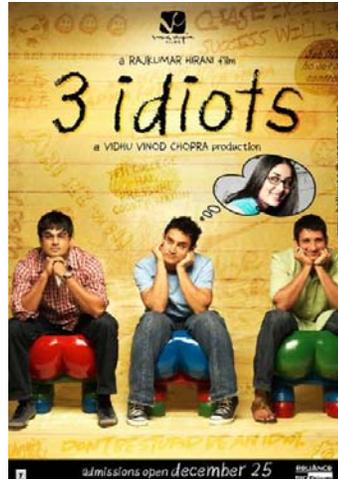
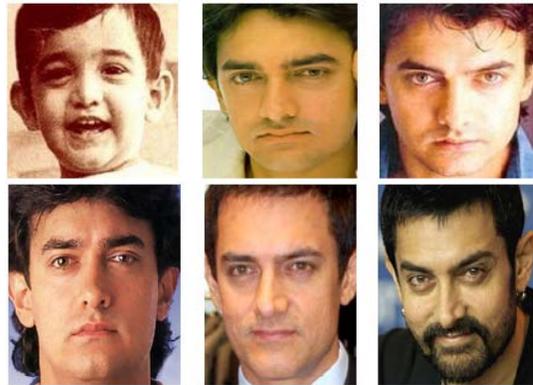


Amir Khan

Kajol Devgan

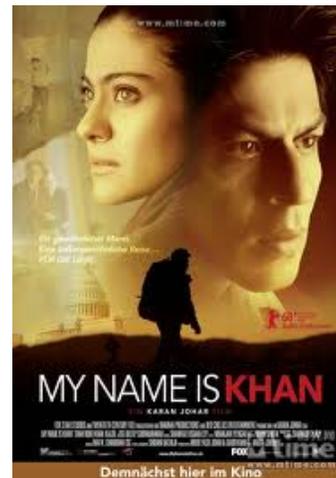


# Delhi face aging database



**RAIN MAN**

Forrest Gump



# Delhi face aging database



- Ground truth
  - Hair color, eye color, beard, mustache, eyebrows, glasses
  - Surroundings
  - Pose
  - Full body or face image
  - Gender, age and ethnicity
  - Smiling or not

# Delhi face aging database



- Ground truth
  - Hair color, eye color, beard, mustache, eyebrows, glasses
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How about the performance of current face algorithms on this real-life database?

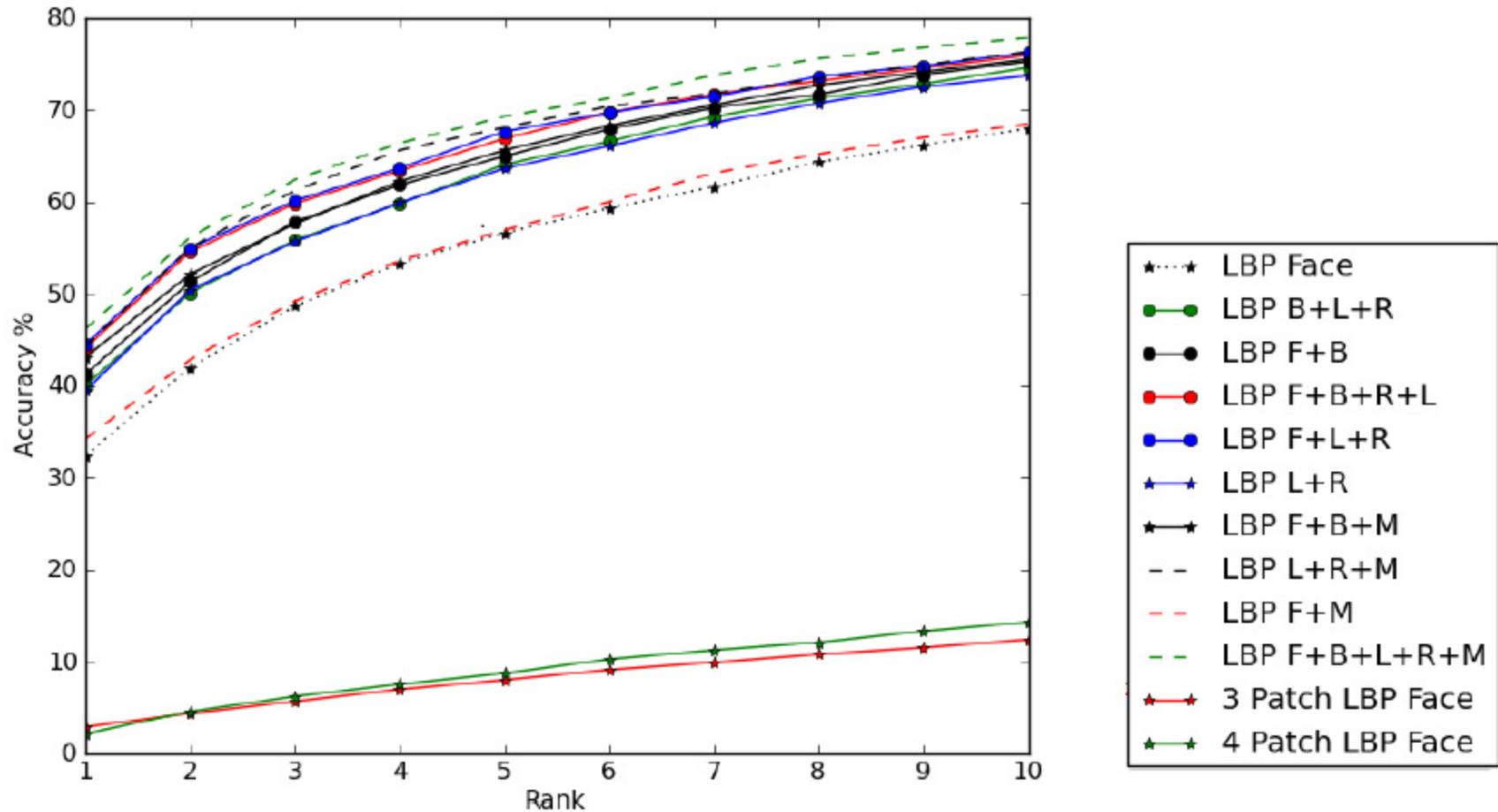
Will the aging behavior different for subjects of different age groups and gender classes?

# Experimental evaluation



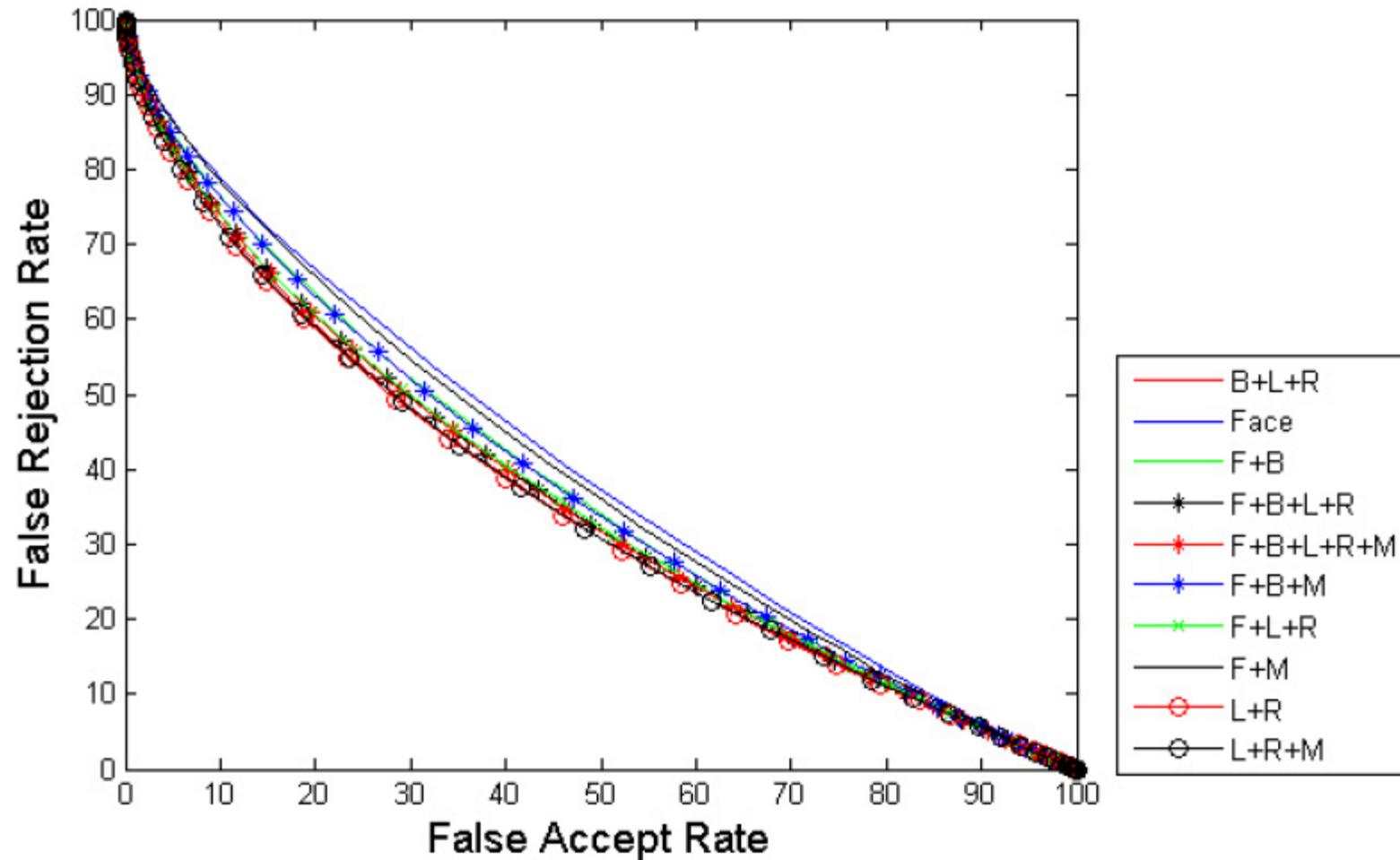
- Q1: performance of current face algorithms
  - Facial features and matching algorithms: local binary patterns (LBP) and its variants, principal component analysis (PCA) of intensity, sparse representation of both intensity and LBP
  - Score fusion of different regions: binocular, left periocular, right periocular and mouth regions
  - Performance measures: cumulative match characteristic (CMC), rank-1 accuracy and receiver operating characteristic (ROC)

# Experimental evaluation



CMC curves obtained from the matching scores of using LBP and its variants.

# Experimental evaluation



ROC curves obtained from the matching scores of using LBP and its variants.

# Experimental evaluation



- Q2: behavior in facial aging for subjects of different age groups and gender classes

Numbers of correctly classified probes, according to the gender.

		Male			
	0-18	19-35	36-55	Above 55	
0-18	0	0	1 (0.038%)	0	
19-35	0	99 (3.78%)	38 (1.45%)	9 (0.34%)	
36-55	0	18 (0.72%)	161 (6.14%)	8 (0.30%)	
Above 55	0	7 (0.26%)	20 (0.76%)	39 (1.48%)	

		Female			
	0-18	19-35	36-55	Above 55	
0-18	0	0	0	0	
19-35	0	203 (7.75%)	28 (1.07%)	11 (0.42%)	
36-55	0	16 (0.61%)	93 (3.55%)	12 (0.45%)	
Above 55	0	8 (0.30%)	11 (0.42%)	65 (2.48%)	



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# Summary



- A computation model to account for and predict transient changes due to aging
  - Some specific areas are best candidates for transient changes.
  - Flexible template capable of tolerating transient changes in face appearance due to short-time aging
- A novel face aging database for long-time aging analysis in unconstrained scenarios
  - Need for better algorithms to cope with real-life variations
  - Different behavior in facial aging for subjects belonging to different gender and age classes



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West Virginia University

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Thanks