Automatic Face Recognition: Yesterday, Today and Tomorrow

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Outline

• Face recognition by humans
• Face recognition by computers
  – Yesterday: history
  – Today: current research
  – Tomorrow: future directions
Why Face?

- People love faces!
  - Sensitive to the face pattern
Why Face?

• People love faces!
  – Natural way to recognise each other
  – Non-intrusion
Face recognition by humans

- Can recognise **familiar faces** in very low-resolution images.

Sinha et al. *Face Recognition by Humans: Nineteen Results Researchers Should Know About*, 2006
Face recognition by humans

- Can recognise familiar faces in very low-resolution images.

Bill Clinton

Bill Clinton

Prince Charles

Sinha et al. *Face Recognition by Humans: Nineteen Results Researchers Should Know About*, 2006
Face recognition by humans

• Dependent on holistic processes involving an interdependency between featural and configural information.

Annan Li et al. *Face Recognition Based on Non-Corresponding Region Matching*, 2011
Face recognition by humans

- Dependent on *holistic* processes involving an interdependency between featural and configural information.

Bill Clinton and George W. Bush

Annan Li et al. *Face Recognition Based on Non-Corresponding Region Matching*, 2011
Face recognition by humans

- Eyebrows are the most important for recognition

Sinha et al. *Face Recognition by Humans: Nineteen Results Researchers Should Know About*, 2006
Face recognition by humans

• Eyebrows are the most important for recognition

Daniel Radcliffe

Emma Watson

Sinha et al. *Face Recognition by Humans: Nineteen Results Researchers Should Know About*, 2006
Face recognition by humans

- **Prosopagnosia**: face blindness
  - I Don't Recognise People Sometimes...
  - Even Myself
- No difficulty in recognise other objects
- Face recognition -- general object recognition
  - by different areas of the brain
Face recognition by humans

• Super-Recogniser:
  NEVER forget the face

• Hidden Talent, Channel 4

• Test your ability of recognising faces:
  – http://www.testmybrain.org/tests/start
Face recognition by computers

- General automatic face recognition (ARF) system
History of ARF


• Semi-automated mode: facial features were extracted from the photographs by humans
History of ARF


- First fully automatic face recognition system
- Facial feature based method
A K Jain, *An Introduction to Biometrics with Applications in Forensics*, 2013
History of ARF


- Appearance based method
- Principal component analysis (PCA)
Face recognition by computers

• Pipeline of current face recognition algorithm

A K Jain, Face Recognition in Forensics and Beyond, 2012
Automatic face recognition

- Where are we now?
Better than humans!

Comparable performance with humans

AFR solved?

- No
- Humans are good at recognising familiar faces
  - Especially in difficult recognition environment
- Computers: still has room for improvement
2011 London Riots

Widespread looting and rioting:

Extensive CCTV Network (1M CCTV cameras in London & 4M in U.K.):

Face recognition lead to many arrests:

Yet, many suspects still unable to be identified by COTS FRS:

A K Jain, An Introduction to Biometrics with Applications in Forensics, 2013
2013 Boston Marathon bombings

Probes

Gallery

Tamerlan Tsarnaev

Dzhokhar Tsarnaev

1 Million PCSO Mugshots

A K Jain, An Introduction to Biometrics with Applications in Forensics, 2013
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A K Jain, *An Introduction to Biometrics with Applications in Forensics*, 2013
Current challenges

• Pose
  – Multi-view method
  – Pose variation modeling
Current challenges

• Illumination
  – Illumination normalization
  – Illumination invariant representation
  – Illumination variation modeling

Gradient faces
Current challenges

- Expression
  - Patch-based methods
  - Warp an affected face to a neutral face

Gass et al, *Warp that smile on your face: Optimal and smooth deformations for face recognition*, 2011
Current challenges

• Ageing
  – Age estimation techniques
  – Ageing robust systems
Unconstrained face recognition

Ageing
Pose
Illumination
Expression
Future directions

• Partial / occluded face recognition
  – Sources of occlusion are unpredictable
Future directions

• Heterogeneous face recognition
  – Images from various sources
  – Sketch-image matching
  – Near-Infrared FR
Future directions

• Others
  – Plastic surgery
  – Make up
What will human face look like in the future?
Questions?

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