EEE-6561 Fundamentals of Biometric Identification

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Lecture #5 Face Detection

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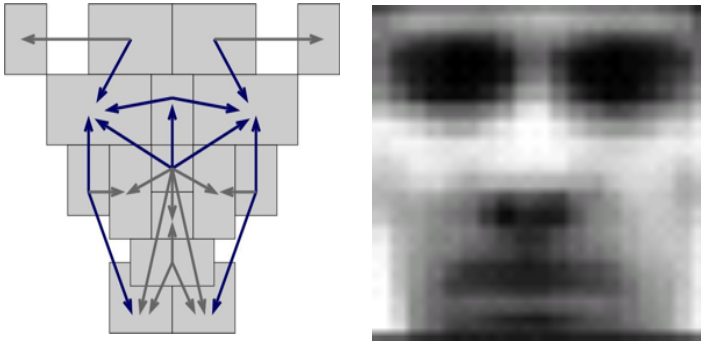
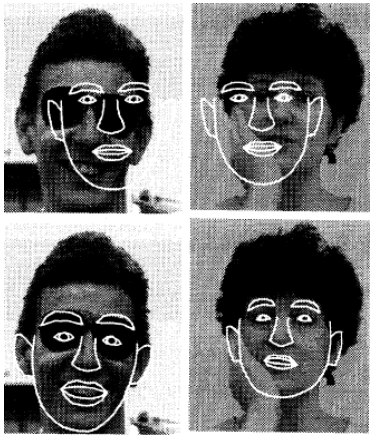
Face Template

- Use relative pair-wise ratios of the brightness of facial regions (14×16 pixels): the eyes are usually darker than the surrounding face [Sinha 94]
- Use average area intensity values rather than absolute pixel values
- See also Point Distribution Model (PDM) [Lanitis et al. 95]



Ration Template [Sinha 94]



average shape

[Lanitis et al. 95]

Template-Based Methods: Summary

- Pros:

  Simple

- Cons:
  - Templates needs to be initialized near the face images
  - Difficult to enumerate templates for different poses (similar to knowledge-based methods)

Appearance Based Methods

- The models (or templates) are learned from a set of training images which capture the representative variability of facial appearance

- Methods differ in:
  - Representation
  - Preprocessing
  - Classifier Training
  - Search strategy
  - Post processing

Appearance-Based Methods: Summary

- **Pros:**
  - Use powerful machine learning algorithms
  - Has demonstrated good empirical results
  - Fast and fairly robust
  - Extended to detect faces in different pose and orientation
- **Cons:**
  - Usually needs to search over space and scale
  - Need lots of positive and negative examples
  - Limited view-based approach

Detecting Faces in Color Images

Idea:

Use skin color information to separate faces from image background

Methods of Skin Detection

- **Pixel-Based Methods**
  - Classify each pixel as skin or non-skin individually, independently from its neighbors
  - Simpler, faster
  - Color Based Methods fall in this category

- **Region Based Methods**
  - Try to take the spatial arrangement of skin pixels into account during the detection stage to enhance the methods performance
  - More computation extensive
  - Additional knowledge in terms of texture etc are required

Skin Color based methods - Advantages

- Allows fast processing
- Robust to geometric variations of the skin patterns
- Robust under partial occlusion
- Robust to resolution changes
- Experience suggests that human skin has a characteristic color, which is easily recognized by humans

Issues with skin color

- Are Skin and Non-skin colors separable?
- Illumination changes over time
- Skin tones vary dramatically within and across individuals
- Different cameras have different output for the identical image
- Movement of objects cause blurring of colors
- Ambient light, shadows change the apparent color of the image
- What color space to be used?

Color-Based Face Detector: Summary

- **Pros:**
  - Easy to implement
  - Effective and efficient in constrained environment
  - Insensitive to pose, expression, rotation variation

- **Cons:**
  - Sensitive to environment and lighting change
  - Noisy detection results

Video-Based Face Detector

- Motion cues:
  - Frame differencing
  - Background modeling and subtraction

- Can also used depth cue (e.g., from stereo) when available

- Reduces the search space dramatically

Video-Based Detectors: Summary

Pros:

- An easier problem than detection in still images
- Use all available cues: motion, depth, voice, etc. to reduce search space

Cons:

- Need for efficient and effective methods to process the multimodal cues
- Data fusion

Conclusion

Face detection is not a solved problem.

Current focus is on detecting faces robustly under

- Varying poses
- Orientation
- Occlusion
- Expression
- Varying illumination
- Low image resolution

Questions?

Slide Credits

Some slides adapted from Ming-Hsuan Yang