Iris Quality from Image Acquisition

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LG Electronics USA Inc.,
Iris Technology Division
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LG at a Glance

• Founded: 1947
• 2006 Total Sales: 93 Billion USD
• Business Fields: **Electronics**, Chemicals, Telecommunication & Services
• Number of Companies: 31
• Overseas Subsidiaries: 130
• Employees: 160,000+
LG Electronics

• Makes many products under LG Brand and as OEM producer
• Consumer Electronics
• Security Business
  – Surveillance/Monitoring
  – Iris Technology
LG Electronics USA Inc. Iris Technology Division

- Began Iris in 1997
- Established US operations in 2002
- Third Generation Product
  - LG 2000/2200 Series
  - LG 3000 Series
  - LG 4000 Series

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Well Known Iris Quality Metrics

- Iris Diameter
- Motion Blur
- Focus
- Contrast
- Visibility (Measure of Occlusion)
- Texture

- Iris recognition performance depends if subject is wearing glasses
Effect of Motion Blur

- Images simulated with linear motion blur (ICE 2005)
- Parameters: direction, extent

Original image  |  Motion Blurred (45°, 10)  |  Motion Blurred (45°, 25)

Effect of Out-of-Focus Blur

- Images simulated with Gaussian blur (ICE 2005)
- Parameters: variance, filter-size

![Original image](image1)
![Gaussian blurred (10)](image2)
![Gaussian blurred (25)](image3)

![Graph 1](image4)
![Graph 2](image5)
Effect of Reduced Contrast

- Original image
- Contrast reduction: 50%
- Contrast reduction: 70%

Graphs showing the effect of contrast reduction on failure to enroll and Hamming distance.
Camera Design to Reduce Motion Blur

- $\uparrow$ Flexibility $\rightarrow$ $\uparrow$ Depth of field

- $\uparrow$ Depth of field $\rightarrow$ $\downarrow$ Aperture

- $\downarrow$ Aperture $\rightarrow$ $\downarrow$ Shutter speed, $\uparrow$ Illumination

- $\downarrow$ Shutter speed $\rightarrow$ $\uparrow$ Motion blur, $\downarrow$ Quality

- Shutter speed has to be high and thus DOF shallow!
Camera Design to Ensure Focus

- If object (iris) not in focus → Blurred image
- To avoid out of focus image → Auto focus lens
- Auto focus lens → Requires the exact position of eyes from camera

Figure reference: howstuffworks
Camera Design to Ensure Focus

Start

Track the distance (D) and speed (S) of subject

NO

Is $S < S_{\text{max}}$ and $D_{\text{min}} < D < D_{\text{max}}$

Yes

Visual Feedback

- Not in range
- In range

10–14”
Camera Design to Ensure Focus

Start

Track the distance (D) & speed (S) of subject

NO

Is S < S_{max} and D_{min} < D < D_{max}

NO

Is Focus > Focus_{min}

YES

End

NO

Locate iris using Wide-angle camera

Take picture using narrow-angle camera

Find focus (F) of iris image
Camera Design to Ensure Contrast

- Modulation transfer function (MTF)
  - Measurement of the lens’ ability to transfer contrast from reference chart to an image plane at specific resolution (lines per mm)

- Contrast (sharpness) → Optical resolution
- ISO standard: at 60% modulation, 4 lp/mm – enough?

Figure reference: Introduction to resolution and MTF curves by Norman Koren
Camera Design to Ensure Quality - Glasses

- If a subject is wearing glasses, there is a possibility of reflections which can affect recognition performance.
Camera Design – Additional Factors

• Single/Two eye camera
  – Two-eye camera has very less scope for rotation of eyes

• CCD/CMOS
  – Size, cost and sensitivity

• Illumination wavelength and power
  – Governed by eye safety standards
Future Work

- Analysis and processing tool for a large collection of iris images from various sources (cameras)
- Evaluation of iris recognition algorithms
- Interoperability study of iris recognition
- Effect of various quality factors on different algorithms

Iris Capture and Analysis Platform (ICAP)
- Will facilitate the analysis and processing of a large collection of iris images
Conclusion

• Iris Diameter, Motion Blur, Focus, Contrast and Optical resolution are important parameters for acquiring high quality iris images
• Wise camera design can eliminate many challenges of iris recognition
• Need of a tool to study effect of quality metrics on different algorithms and images from different sensors
Thank you!

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