

Iris Quality from Image Acquisition

Samir Shah

**LG Electronics USA Inc.,
Iris Technology Division
November 8th, 2007**

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+**

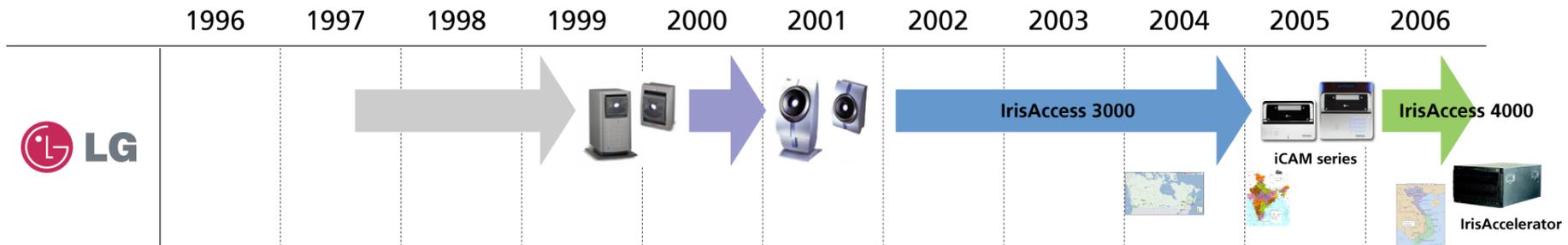
LG Electronics



- **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



Contents

- **Importance of Iris Quality**
- **Camera Design to Ensure Quality**
- **Future Work**
- **Conclusion**

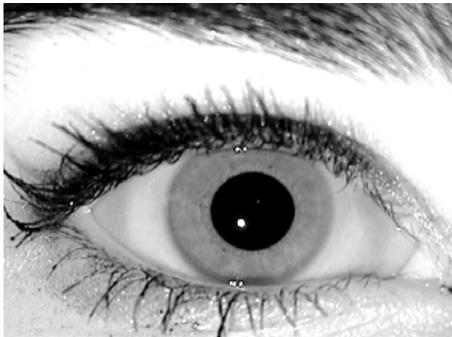
Well Known Iris Quality Metrics

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

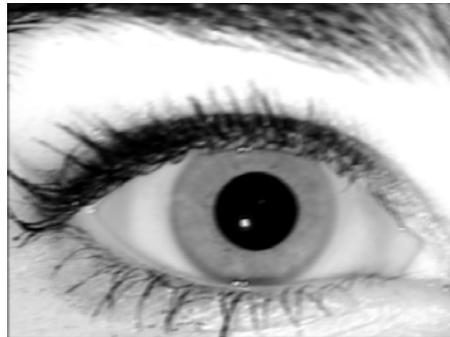
- **Iris recognition performance depends if subject is wearing glasses**

Effect of Motion Blur

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



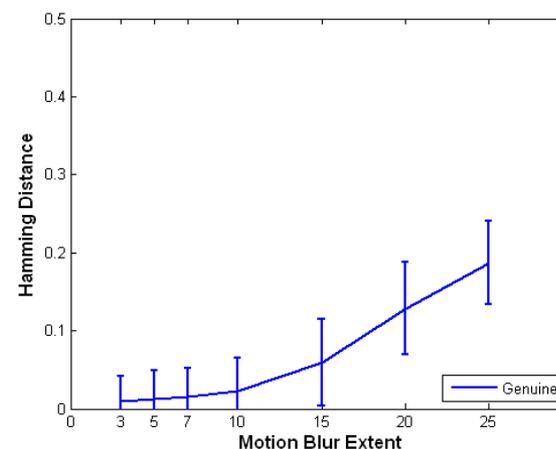
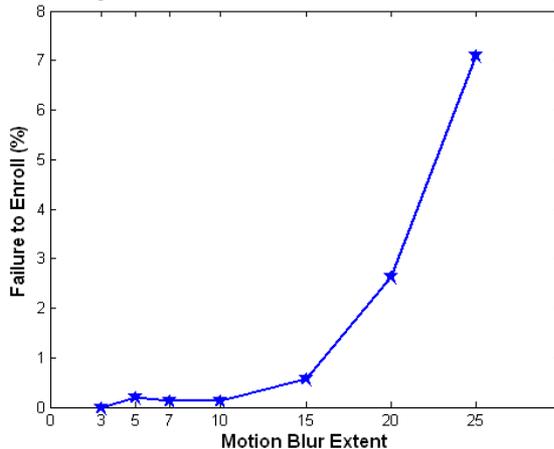
Original image



Motion Blurred (45°, 10)

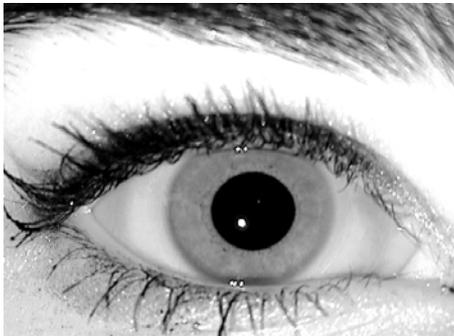


Motion Blurred (45°, 25)



Effect of Out-of-Focus Blur

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



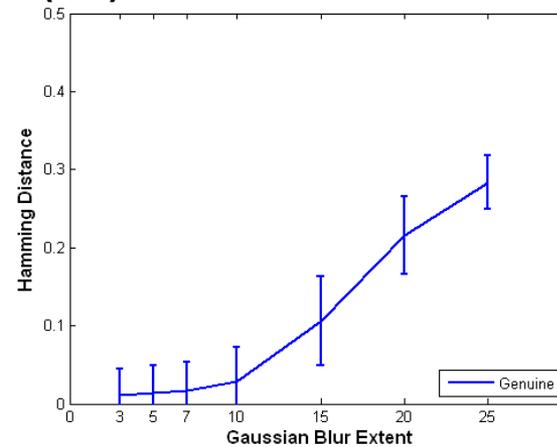
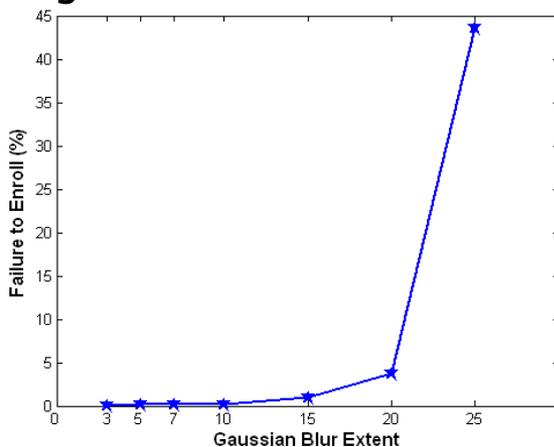
Original image



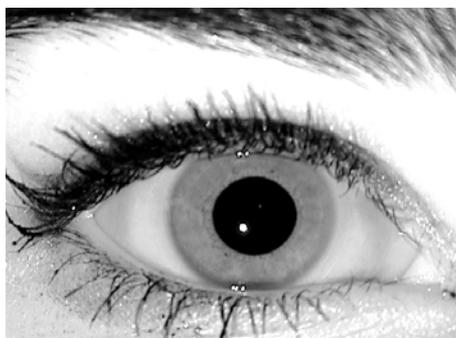
Gaussian blurred (10)



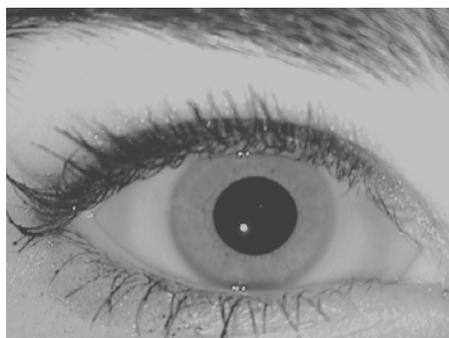
Gaussian blurred (25)



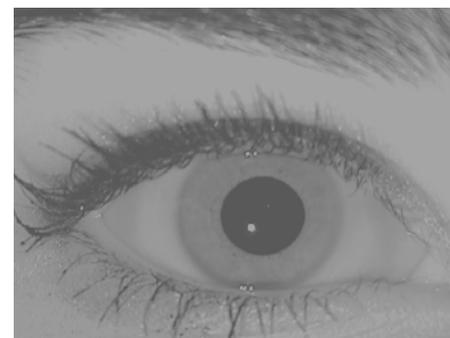
Effect of Reduced Contrast



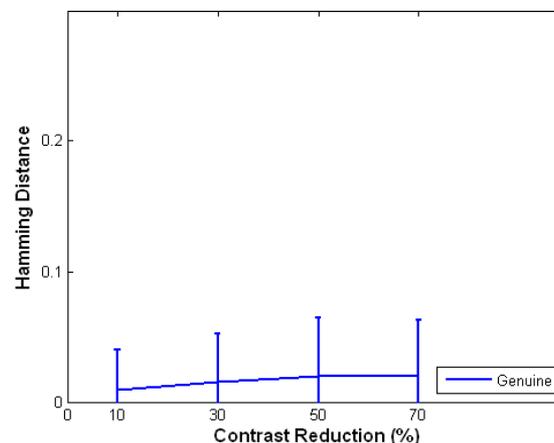
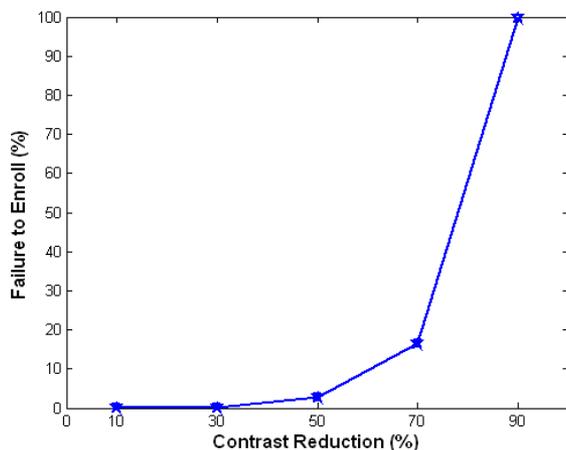
Original image



Contrast reduction: 50%

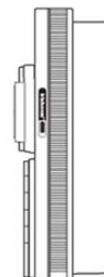
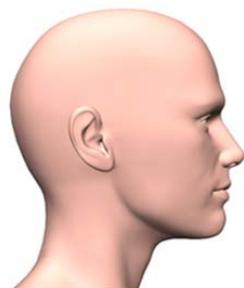
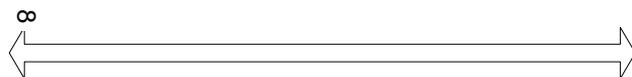


Contrast reduction: 70%

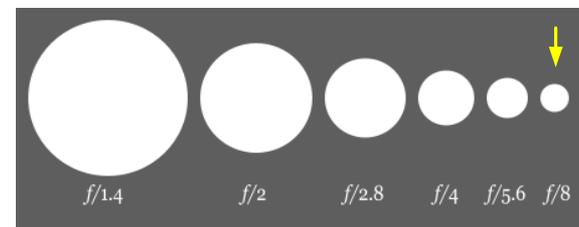


Camera Design to Reduce Motion Blur

- ↑ Flexibility ⇒ ↑ Depth of field



- ↑ Depth of field ⇒ ↓ Aperture

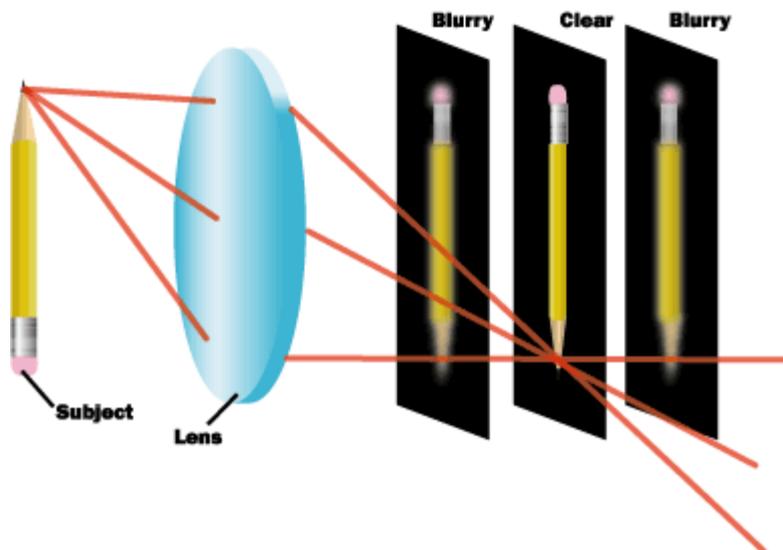


- ↓ Aperture ⇒ ↓ Shutter speed, ↑ Illumination

- ↓ Shutter speed ⇒ ↑ Motion blur, ↓ Quality

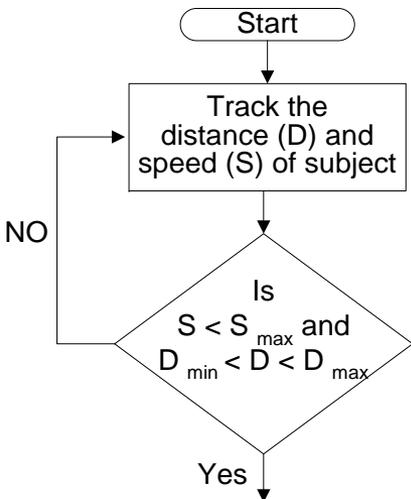
- Shutter speed has to be high and thus DOF shallow!

Camera Design to Ensure Focus

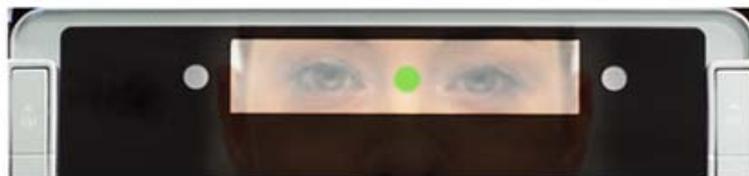


- If object (iris) not in focus ➔ Blurred image
- To avoid out of focus image ➔ Auto focus lens
- Auto focus lens ➔ Requires the exact position of eyes from camera

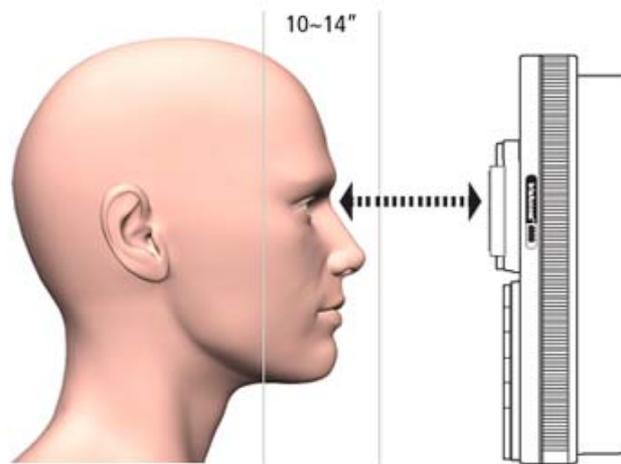
Camera Design to Ensure Focus



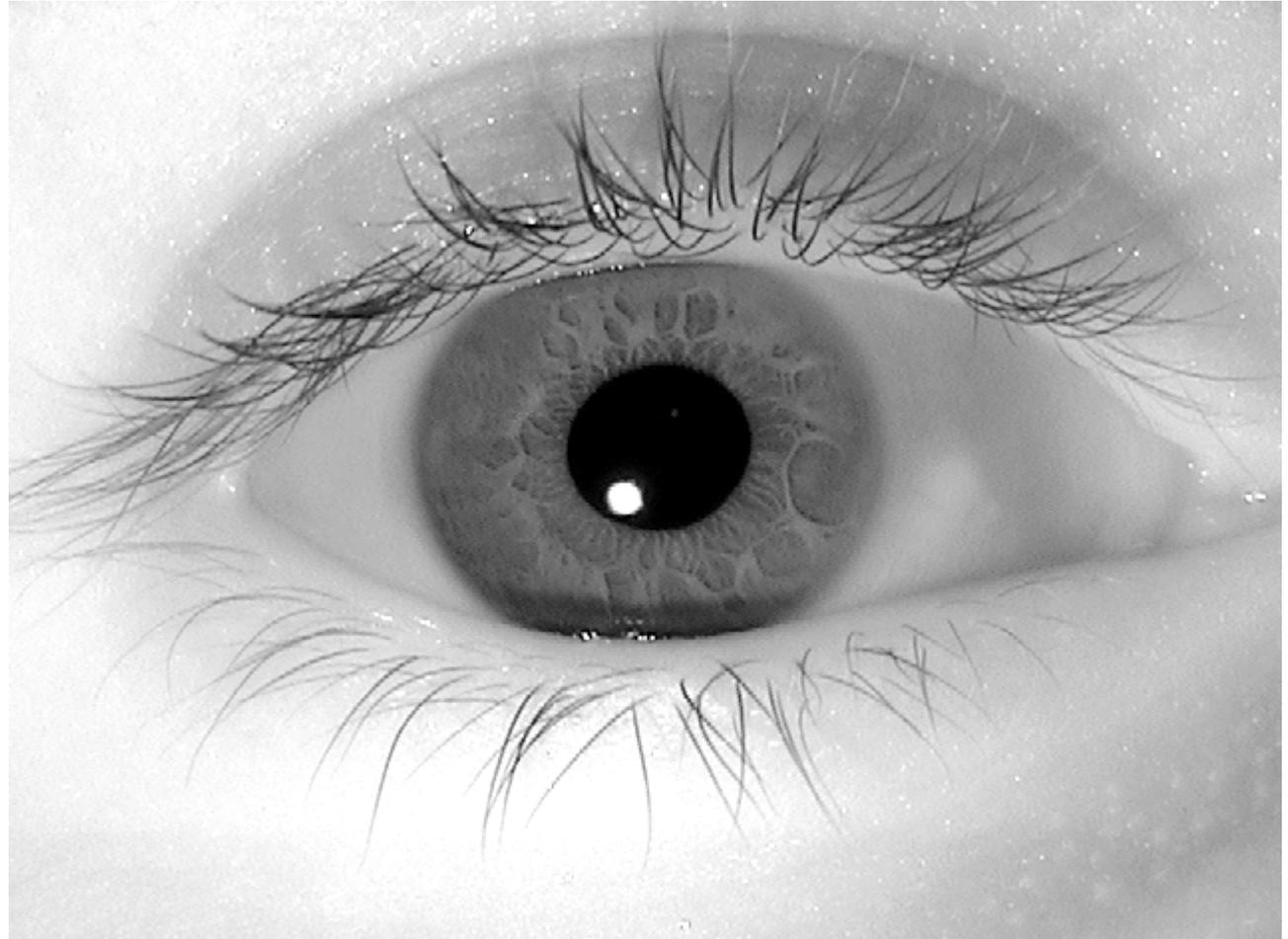
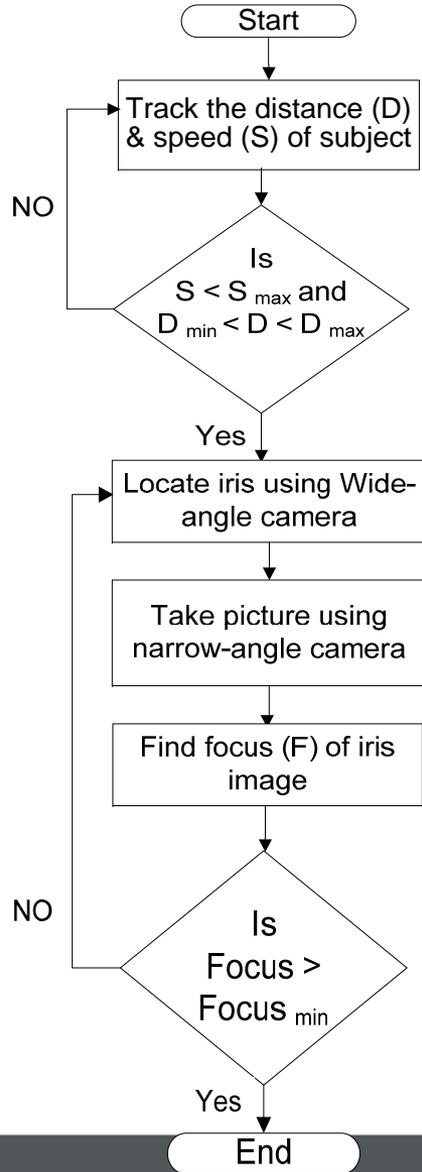
Visual Feedback



- Not in range
- In range

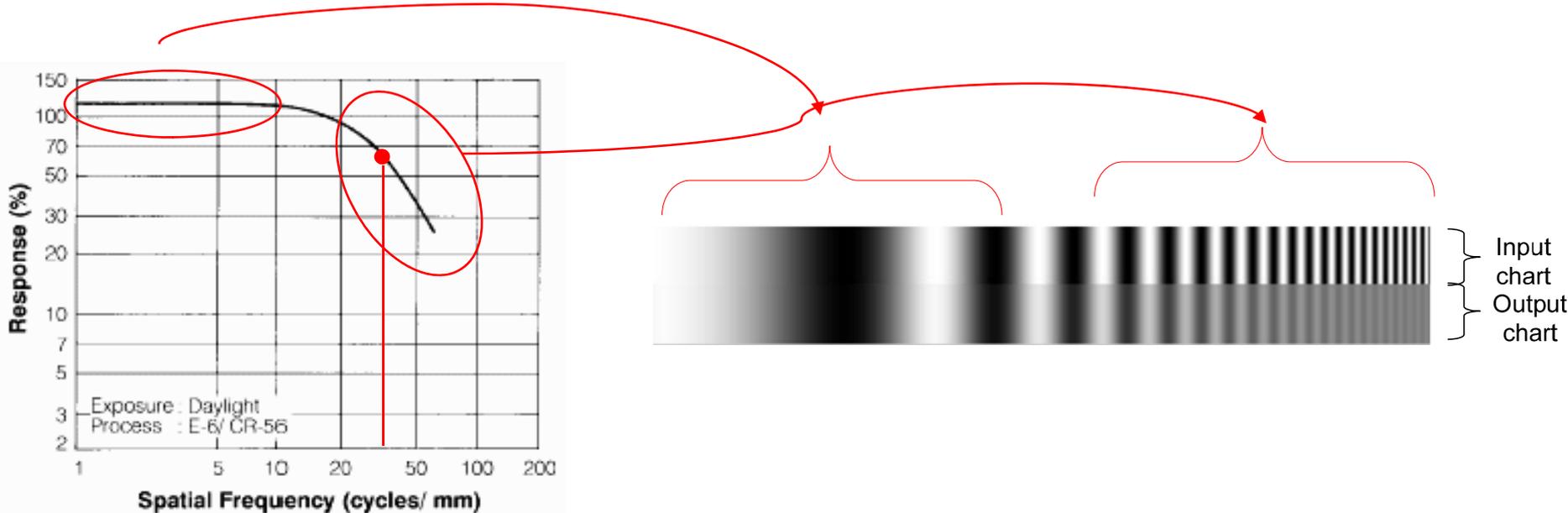


Camera Design to Ensure Focus



Camera Design to Ensure Contrast

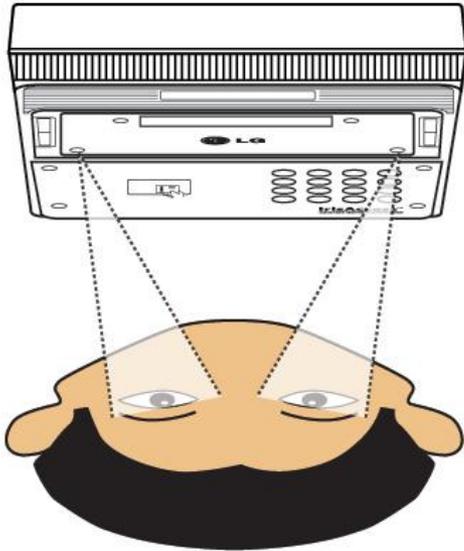
- Modulation transfer function (MTF)
 - Measurement of the lens' ability to transfer contrast from reference chart to an image plane at specific resolution (lines per mm)



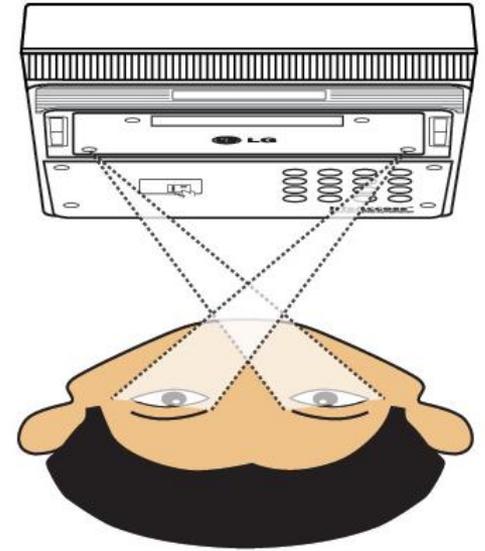
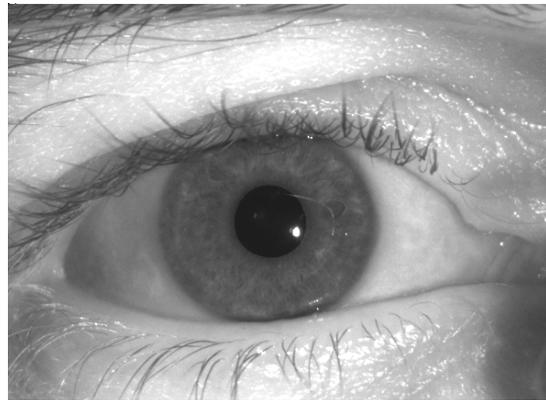
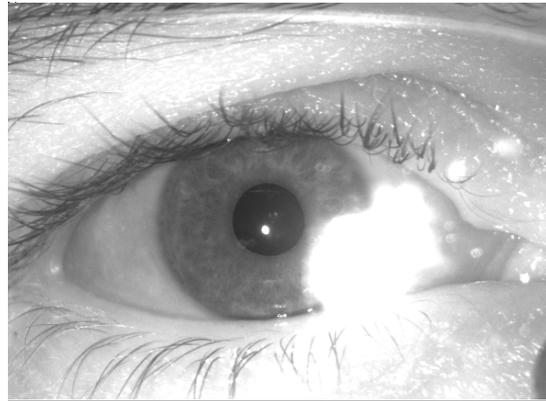
- ↑ Contrast (sharpness) ⇒ ↑ Optical resolution
- ISO standard: at 60% modulation, 4 lp/mm – enough?

Camera Design to Ensure Quality - Glasses

- If a subject is wearing glasses, there is a possibility of reflections which can affect recognition performance



Direct Illumination



Cross Illumination

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!

Contact Information:

Samir Shah

sshah@lgiris.com