Multispectral Fingerprint Sensors

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Product Goal
An *Effective* Biometric Solution

- Provides biometric security …
  1. … *and* distinguishes between real and fake samples
  2. … *and* tolerates normal variations in skin and sampling conditions
  3. … *and* is able to work under extended environmental conditions
Technological Approach

• Optical fingerprinting using **multiple, different images** taken on a **single sensor** during a **single finger placement**
  
  – “Multiple, different images”
    • Different illumination wavelengths
    • Different polarization conditions
    • Different optical geometries
    ➢ *Surface and subsurface features*

  – “Single sensor, single finger placement”
    • No extra user actions
    • Imperceptible difference in acquisition speed
Multispectral Imager (MSI)

• Arrange optics to image skin
• Use multiple illumination colors
• Use different polarization conditions
Multispectral Sensor

Relevant Fingertip Physiology

- The capillary pattern mirrors the surface features of the fingertips
- An image of the blood vessels provides an “internal fingerprint”


Optical absorption due to blood
(Note: semi logarithm scale)

Configuration Options

• Two-camera configuration
  – Adds additional capabilities to a standard sensor while maintaining base operation

• Also in development, a single-camera configuration
  – Fewer components
  – Flexible form factor
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1. Distinguishing Real and Fake Samples

• Spoofs with “unnatural” coloration are straightforward to detect with MSI
  – “Gummy Bear”

• Realistic 3D spoofs and very thin spoofs are worth further discussion …
1. Distinguishing Real and Fake Samples

Realistic 3D Spoof

The spectral characteristics of blood and other tissue components are hard to match with artificial pigments.
1. Distinguishing Real and Fake Samples
Thin Spoofs

- Real fingerprint seen through the spoof
- Thin film
- Platen

Real fingerprint seen through the spoof

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2. Tolerates Normal Variations in Sampling and Skin Conditions

Raw Image

Binary Image

TIR

MSI

3 planes mapped to RGB

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2. Tolerates Normal Variations in Sampling and Skin Conditions

- Third-party testing conducted on 10 MSI/TIR prototypes
  - 2-month study
  - 260+ people
  - 34,000+ samples
  - Mixed blue-collar / white-collar demographics
  - Infrequent sampling (non-habituated users)
  - No instructions or feedback
  - Round-robin, single-sample enrollment
  - Matching on all samples (across sensors)
2. Tolerates Normal Variations in Sampling and Skin Conditions

- Equal Error Rates
  - TIR: ~6%
  - MSI: ~3%
  - System: ~2%

- No systematic usage problems observed

- Polling results were very positive
3. Extended Environmental Conditions

Dirt on Finger and Platen

TIR

MSI
3. Extended Environmental Conditions
Water on the Platen

- 1186 samples taken on 6 sensors
- 44 fingers from 11 people
- Multiple visits across a 5-day span
- Single-sample enrollment
- 39,644 comparisons
Summary

Lumidigm is developing a family of optical fingerprint sensors that can...

1. ... distinguish between real and fake samples
2. ... tolerate normal variations in skin and sampling conditions
3. ... work under extended environmental conditions
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