Fingerprint Authentication

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Authentication

- Nontransferable (possession based)
  - Keycard
  - Fingerprint

- Transferable (knowledge based)
  - Password
  - Certificate
Overview of System

- Two operation modes
  - Add to database
  - Validate a user
System Operation (Database Entry)
System Operation (Validation)
Validation

- The same fingerprint differs between images:
  - Translation
  - Rotation
  - Scaling
  - Noise
Validation

- How to match two fingerprint images?

- Two Methods:
  - Feature Matching
  - Pattern Matching
Feature Matching

- Locate specific characteristics of the fingerprint (minutiae), where ridges end or branch
- Match minutiae between images
- Considered the more accurate algorithm
- Usually implemented through software, and difficult to implement with digital logic
Pattern Matching

- Simple idea (maybe better for 6.111): overlay images and see if they match
- Problems…
  - Noise: Set a threshold. If it’s “close”
  - Translation: Use convolution
  - Rotation: User training
  - Scaling: Will consider this a noise problem
Conclusion

- Fingerprint ID
- Pattern matching validation
- Compute convolution sum and compare to threshold
How Convolution Works

2D Convolution Controller

\[ y[n, m] = \sum_{k=-\infty}^{\infty} \sum_{l=-\infty}^{\infty} p[k, l] x[n-k, m-l] \]

Pattern Buffer  Image Buffer

image

max overlap  24  25  23  23

pattern
Detailed Block Diagram

Controller
- pattern
- read data
- write data
- mem busy
- scan
- program
- LEDs
- start scan
- scan busy
- load img
- load pat
- rst max
- n cnt
- max
- m cnt
- start
- conv busy
- out
- reset
- in
- max

Memory Interface
- pattern sel
- n
- m
- data out
- data in
- start read
- start write
- busy

SRAM

Scanner Controller
- n
- m
- data out
- start
- busy
- img in
- pattern in
- load img
- load pat

Scanner

2D Convolution Controller
\[ y[n, m] = \sum_{k=-\infty}^{\infty} \sum_{l=-\infty}^{\infty} p[k, l] x[n - k, m - l] \]

Pattern Buffer
Image Buffer