Fingerprint Authentication

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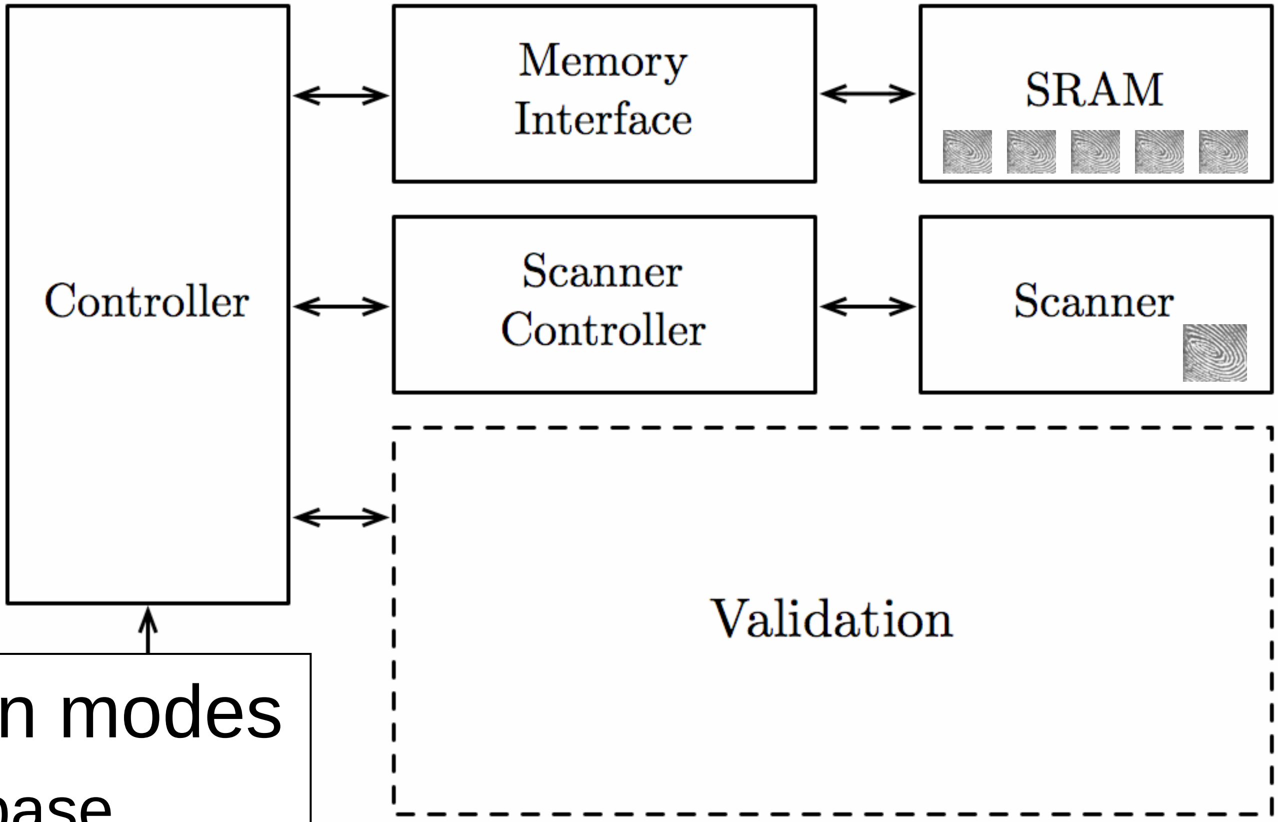
April 26, 2006 - MIT Course 6.111 Project Presentations

Authentication

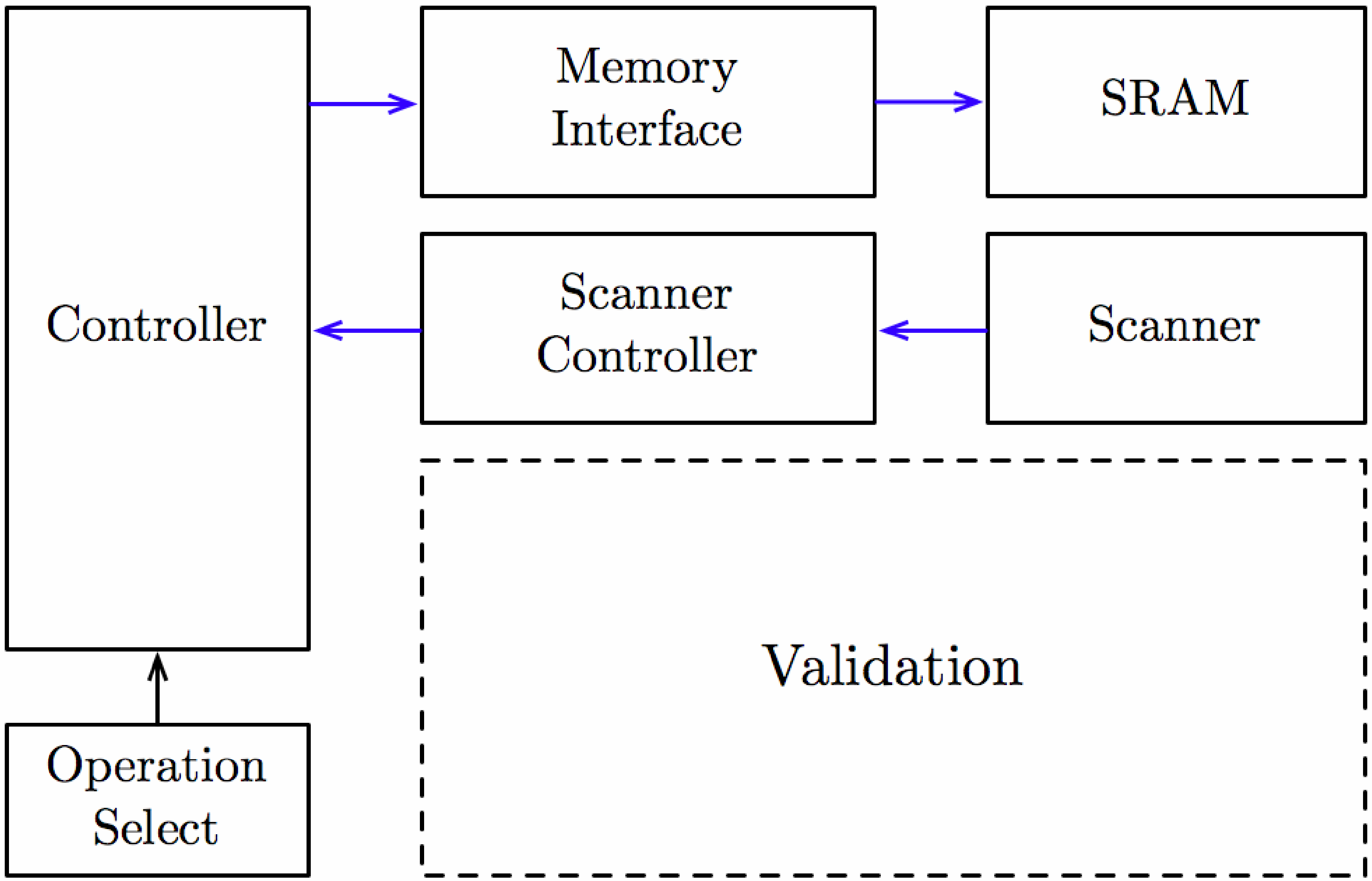
- Nontransferable (possession based)
  - Keycard
  - Fingerprint
- Transferable (knowledge based)
  - Password
  - Certificate

Overview of System

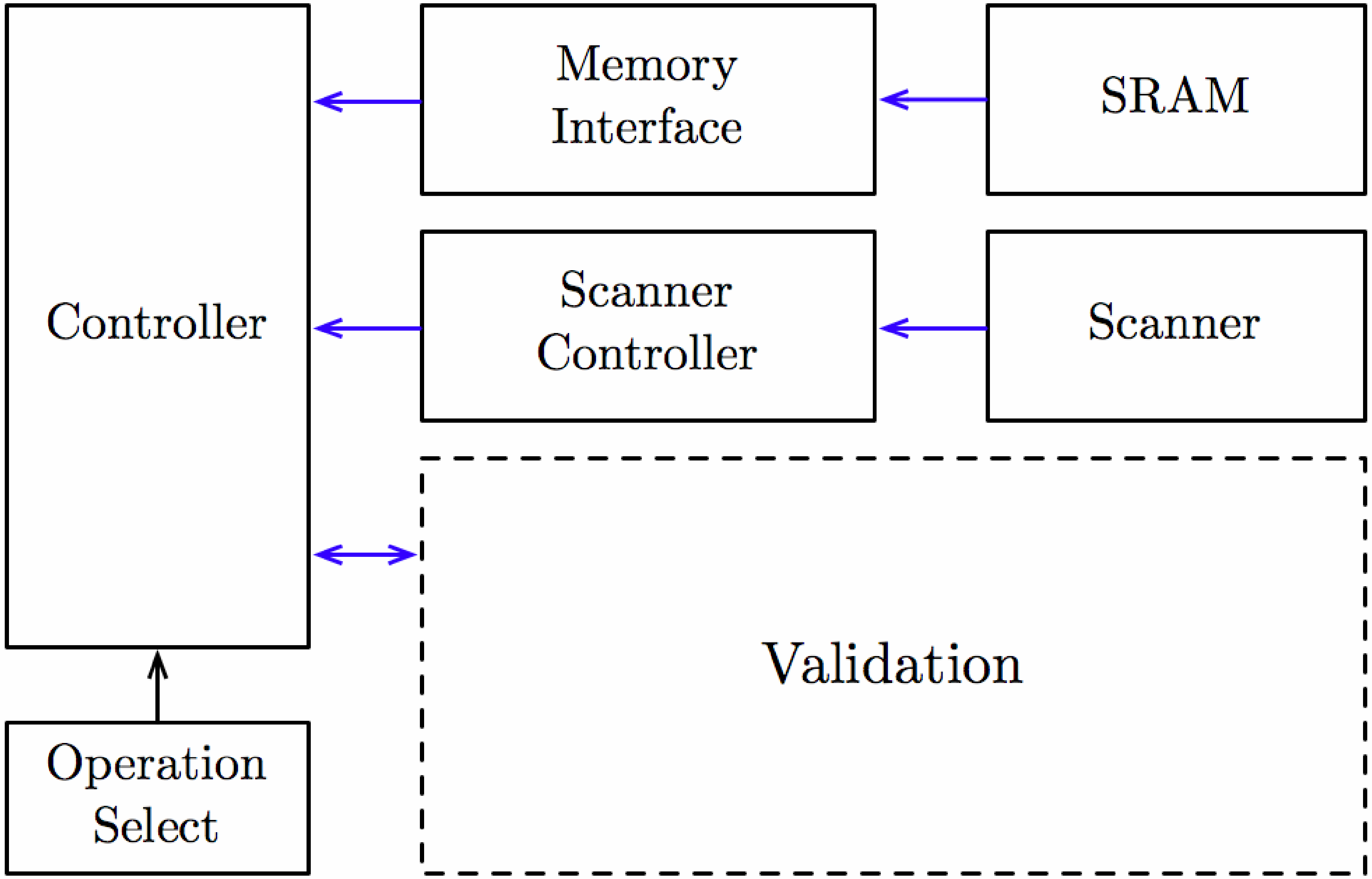


- Two operation modes
    - Add to database
    - Validate a user

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

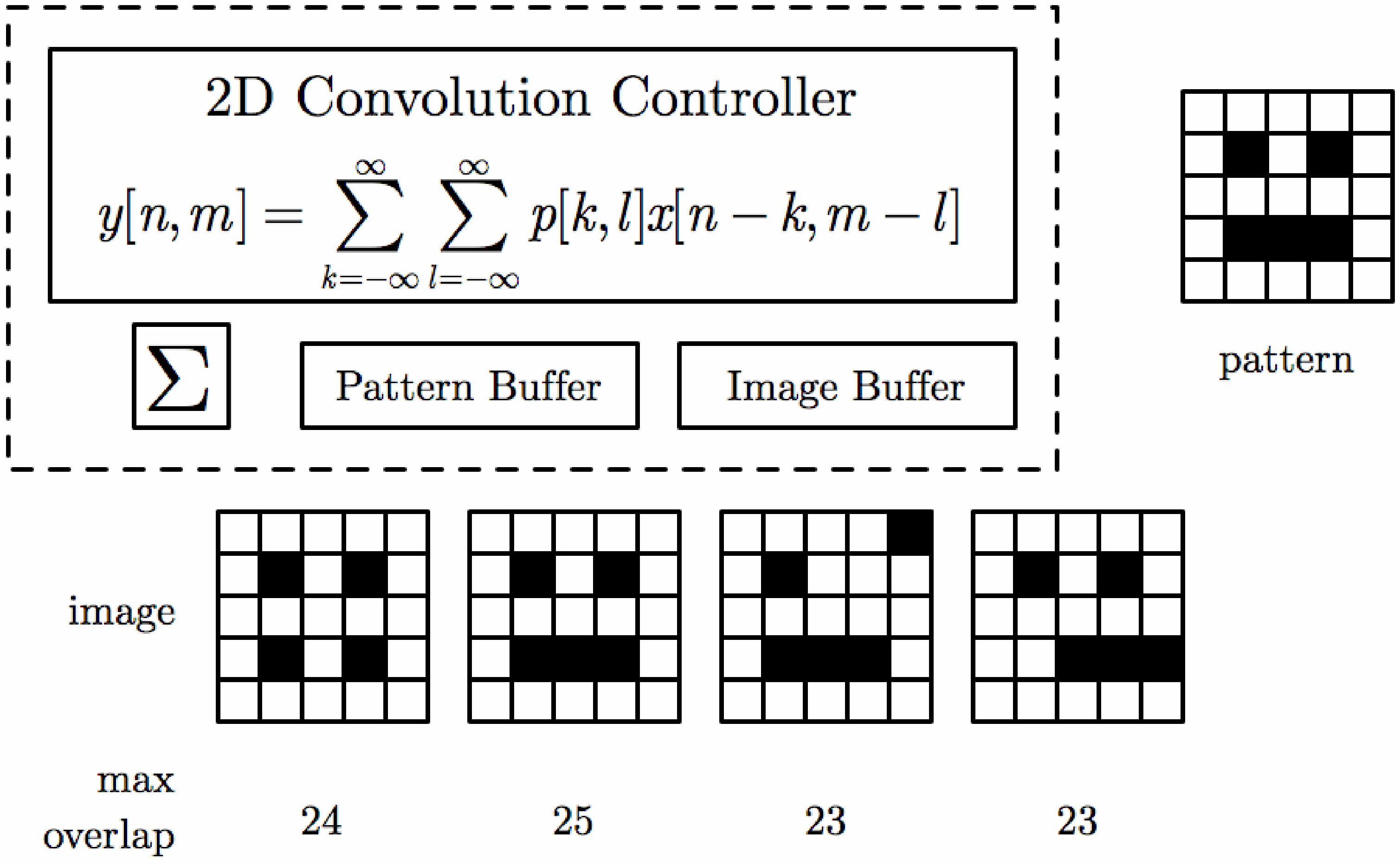
Pattern Matching

- 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

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

Σ

Pattern Buffer

Image Buffer

pattern

image

max overlap

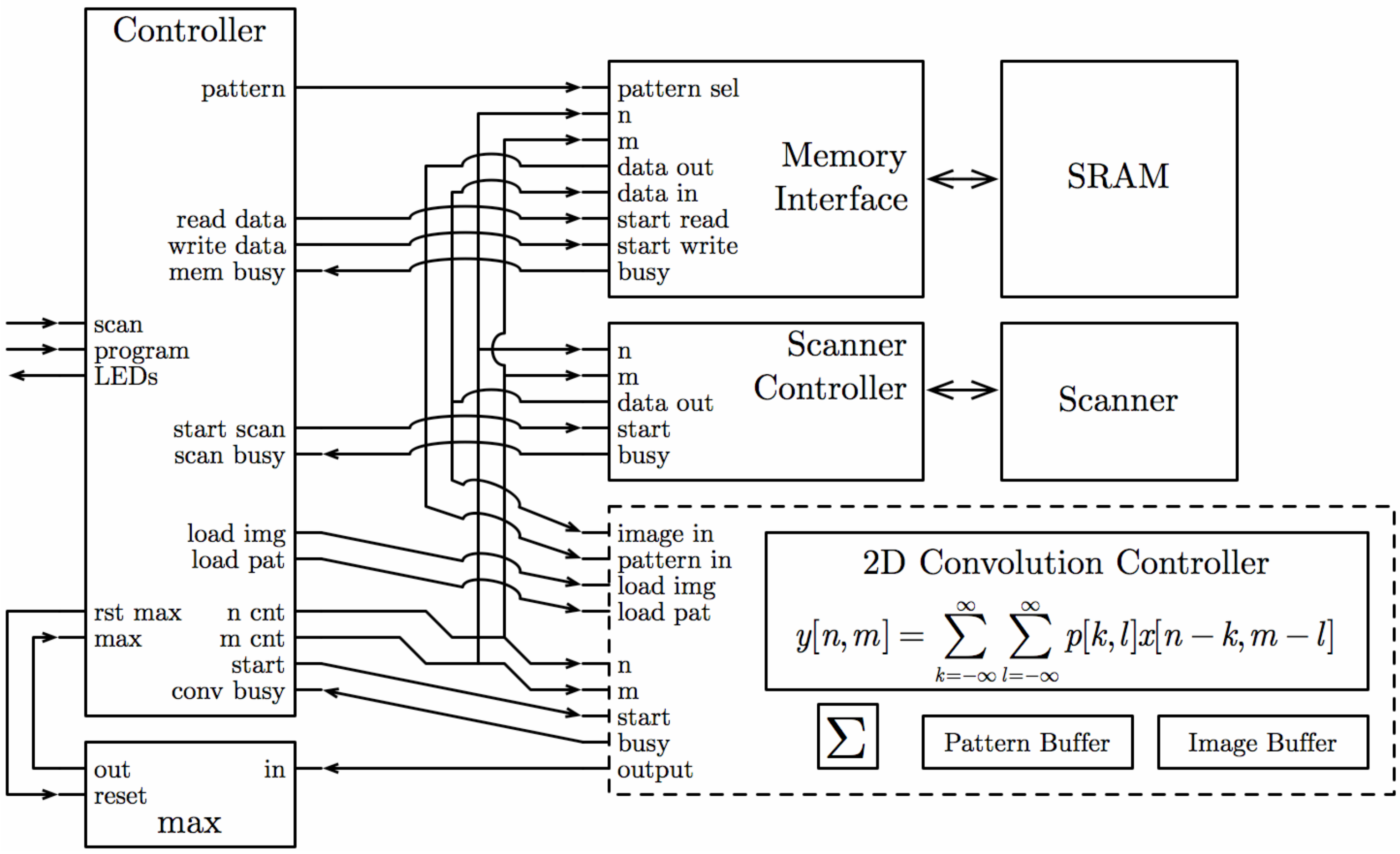
24

25

23

23

Detailed Block Diagram



Controller
pattern
read data
write data
mem busy
scan
program
LEDs
start scan
scan busy
load img
load pat
rst max
max
n cnt
m cnt
start
conv busy
out
in
reset
max
pattern sel
n
m
data out
data in
start read
start write
busy
Memory Interface
SRAM
n
m
data out
start
busy
Scanner Controller
Scanner
image in
pattern in
load img
load pat
n
m
start
busy
output
2D Convolution Controller
$y[n,m] = \sum_{k=-\infty}^{\infty} \sum_{l=-\infty}^{\infty} p[k,l]x[n-k,m-l]$
$\sum$
Pattern Buffer
Image Buffer