I/O Software, Inc.

Auto-Capture Using Multi-Sampling

Jay Hajeer,
Glen Ireland, Daven Williams
email: { jhajeer , gireland , dwilliams }@iosoftware.com

March 9th, 2006

Abstract

- *As agencies build large databases of fingerprint images for purposes of confirming identity, it is clear minimum fingerprint image quality standards must be enforced [1].*

- *Additionally, there is a migration towards capturing four-finger slaps and submitting images using the Type 14 record format [2].*

Improving fingerprint image quality starts at the point of capture

- *This presentation describes a technique for controlling quality when capturing slap fingerprint images. The technique uses auto-capture and multi-sampling in the image acquisition software layer.*

Auto-Capture Using Multi-Sampling

- I/O Software has devised a technique named "*Auto-Capture Using Multi-Sampling*" for capturing slap images in its Live-scan Capture Suite (LCS) client Middleware product.

- This technique is implemented in the image acquisition layer
  - Live-scan hardware does not need to support auto-capture
 - Multi-threaded design allows user interface to present feedback while multi-sampling occurs

Software Layers

LCS User Interface
LCS Image Acquisition Layer
Scanner Driver
Fire-wire/USB2 Interface

Auto-Capture Using Multi-Sampling Code

Scanner

Multi-Sampling Process

| fr[i] | fr[i+1] | fr[i+2] | fr[i+3] | fr[i+4] | fr[i+5] | fr[i+6] |
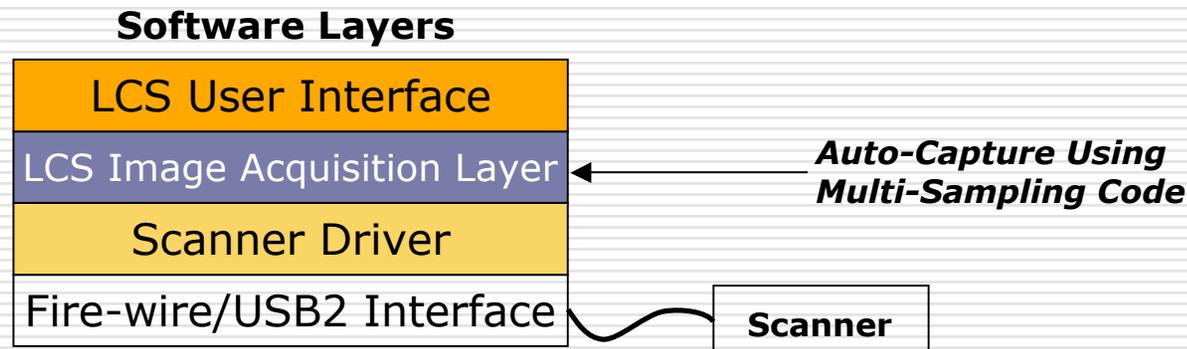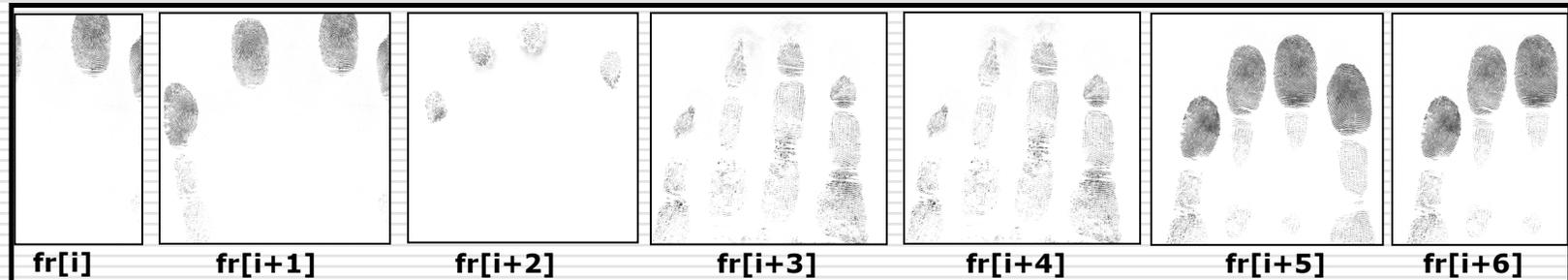
Array of Frames in Live-scan Buffer

- Images in live-scan buffer are evaluated frame-by-frame
  - Image pixel data is measured using quality comparators
  - Image is discarded if a quality comparator returns false
- Process is repeated with subsequent image frames
  - Image is auto-captured if every quality comparator returns true

*Note: Multi-sampling often implies averaging. In this process, only one acceptable image is captured. The process does **not** average multiple images.*

Quality Comparators

- Quality comparators have the following attributes
  - Accept slap or segmented finger image pixel input
  - Measure quality of image against minimum threshold
  - Return boolean result (true or false)

- Comparators are used in order
  - Fastest comparator is used first
  - Comparators that do not require segmentation are used first

- Sample set of comparators
  - Slap quality (pre-segmentation)
  - Minutia count (post-segmentation)
  - NFIQ finger quality (post-segmentation)

Sample Data Points

fr[i]	fr[i+4]	fr[i+6]

Comparator	Measured	Threshold
Slap Quality	87	>70
Minutia Count		
Left Index	**6**	**>40**
Left Middle	47	>40
Left Ring	48	>40
Left Little	56	>30
NFIQ		
Left Index	2	< 4
Left Middle	1	< 3
Left Ring	1	< 3
Left Little	1	< 3

Comparator	Measured	Threshold
Slap Quality	**68**	**>70**
Minutia Count		
Left Index	14	>40
Left Middle	20	>40
Left Ring	10	>40
Left Little	9	>30
NFIQ		
Left Index	2	< 4
Left Middle	2	< 3
Left Ring	3	< 3
Left Little	2	< 3

Comparator	Measured	Threshold
Slap Quality	90	>70
Minutia Count		
Left Index	56	>40
Left Middle	65	>40
Left Ring	48	>40
Left Little	52	>30
NFIQ		
Left Index	1	< 4
Left Middle	1	< 3
Left Ring	1	< 3
Left Little	1	< 3

Failed Minutia Count!   **Failed Slap Quality!**   **Passed!**

User Interface Feedback

- Subject and operator see color borders around slap image during multi-sampling and auto-capture
- Audible beep is heard while subject's hand should remain on scanner
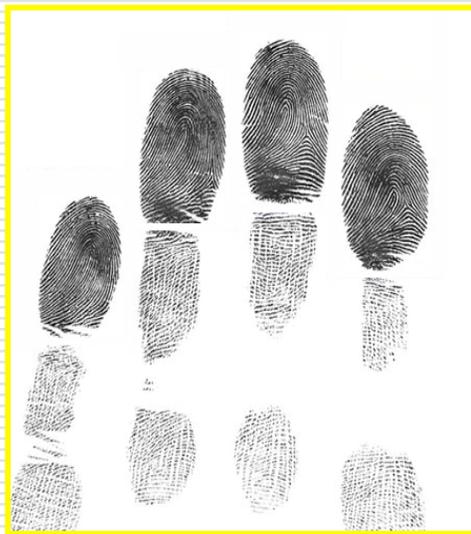
Yellow border displayed during multi-sampling → Blue border appears during auto-capture → Boxes drawn around segmented fingers after auto-capture
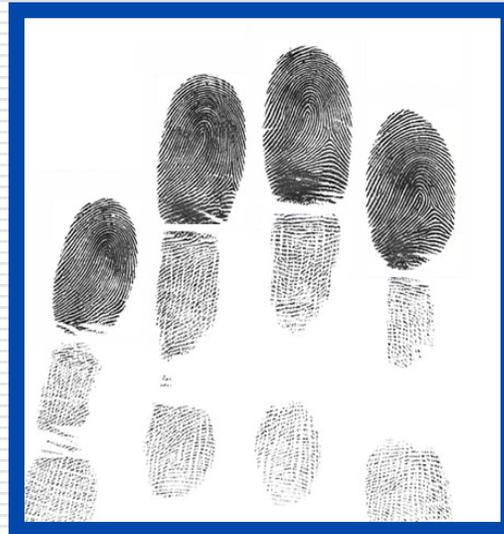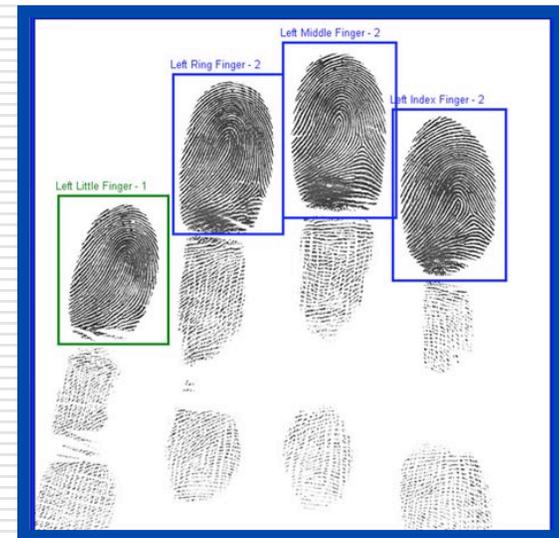
Override Functionality

- Periodically, subjects have missing or badly damaged fingerprints.
  - Multi-sampling accepts quality images with missing fingers
  - Annotation tool can designate fingers as amputated or 'unable to print' before and/or after auto-capture
- Multi-sampling process will eventually force capture if no acceptable image is found
  - Fingers of low quality are automatically marked 'unable to print'
    - EFTS Field 2.084
    - 'UP' designation
 - Operator can manually adjust boxes drawn around segmented fingers

Annotation Tool
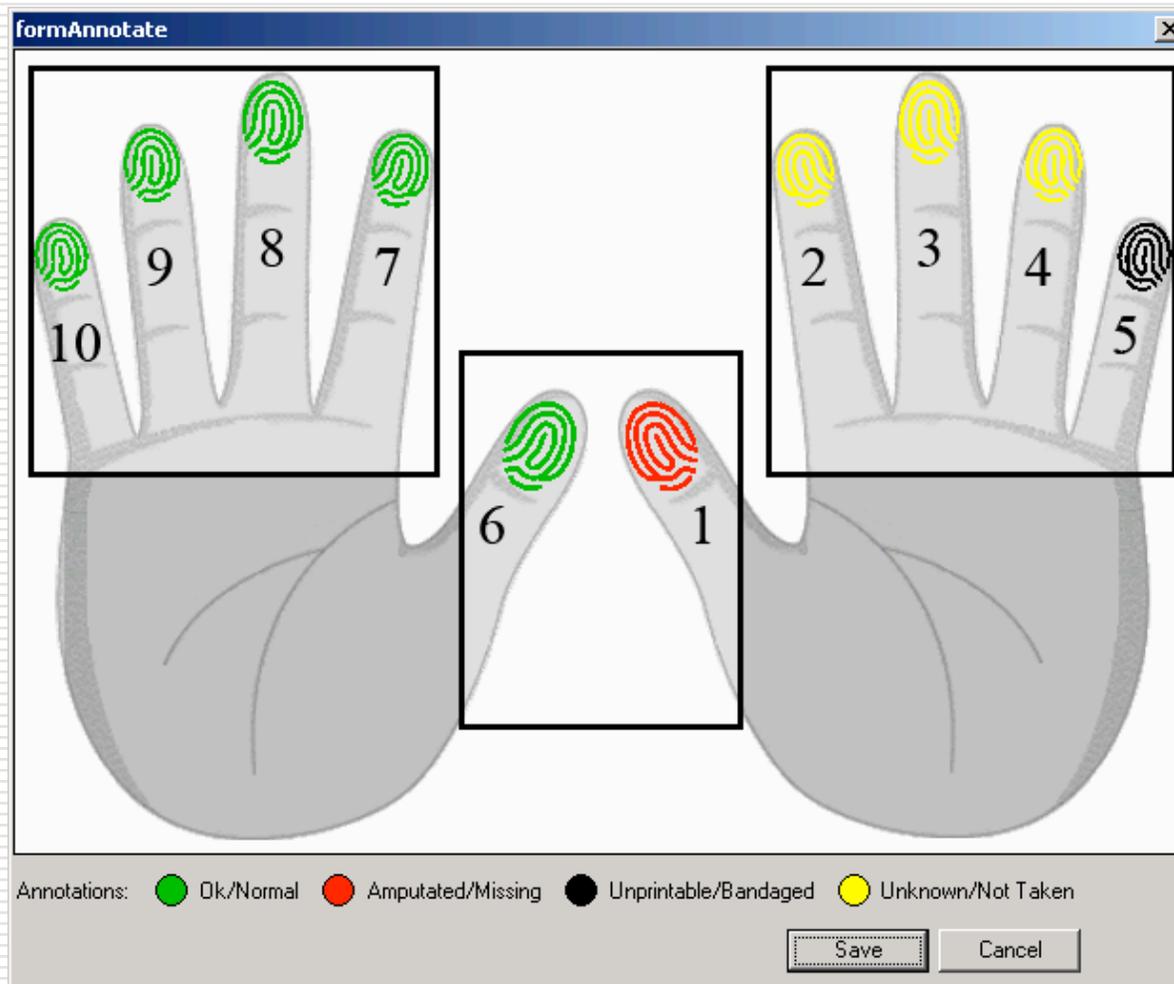
Finger can be designated as amputated or unprintable before or after auto-capture

Moveable Segmentation Boxes
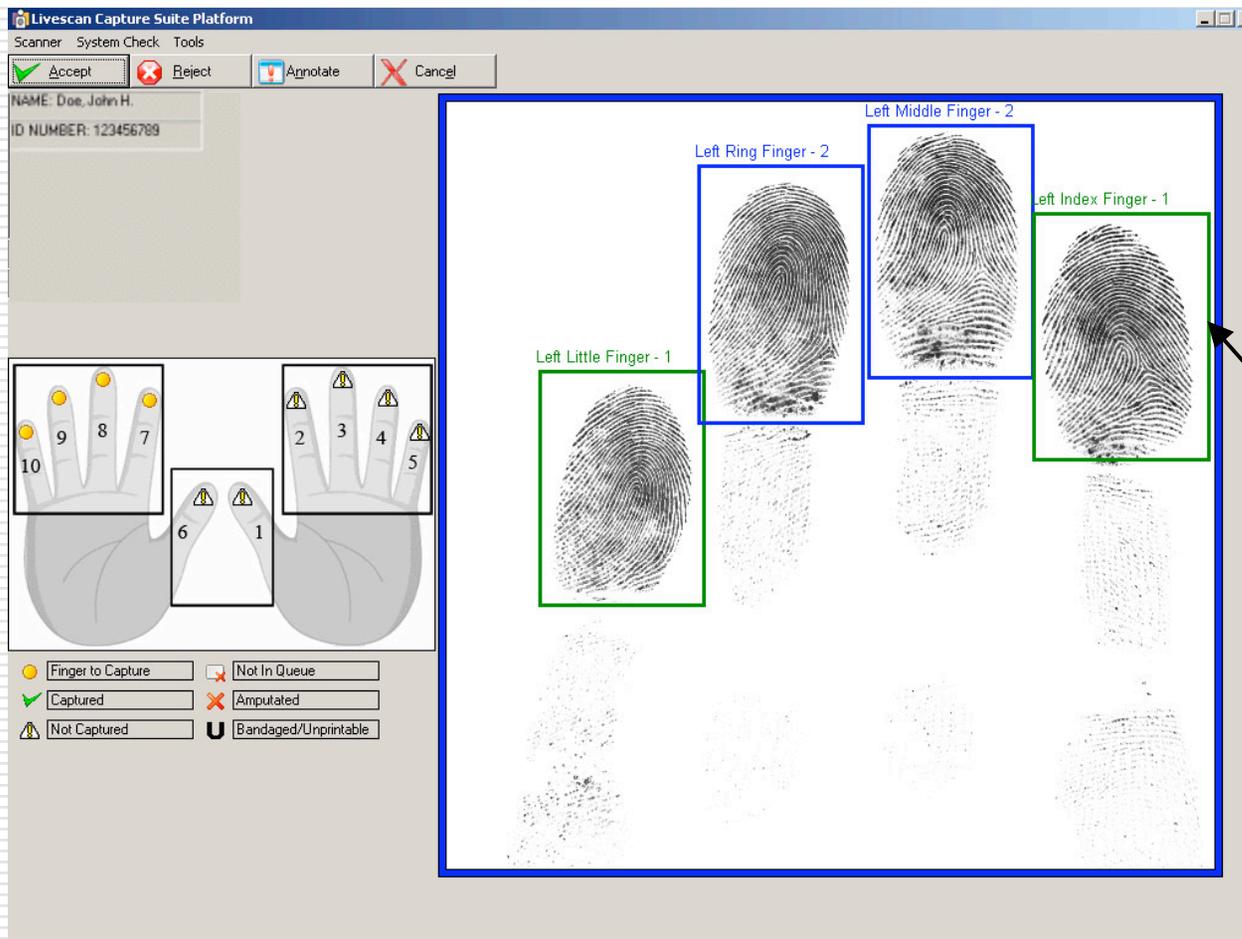
Segmentation boxes can be manually resized after auto-capture

Multisampling Capture Process Overview

Auto-Capture with Multisampling Image Capture Process — TenPrint Flats Type-14

Frames From Scanner | **Left 4 Fingers** | **Stop Frames** | **Right 4 Fingers**

Quality Comparators:
- Analyze Slap and if Image Pixel quality >= Threshold — **False**
- Analyze Slap and if Image Pixel quality >= Threshold — **False**
- Analyze Slap and if Image Pixel quality >= Threshold — **True**
- Segmentation & Scoring Minutia Count Check Finger Quality Check
- User Intervention needed? — **False**

User Interface

Conclusions

- *Auto-Capture Using Multi-Sampling* reduces image quality decisions made by operator

  - Operator no longer decides when to click capture
  - Quality comparators can be optimized based on use case

- User interface needs to assist operator when subject's fingerprints do not exceed minimum quality

  - Annotation tool
  - Manually adjustable segmentation boxes

References

[1] Elham Tabassi, Charles L. Wilson, Craig I. Watson, Fingerprint Image Quality, NISTIR 7151, August 2004 (http://fingerprint.nist.gov/NFIS/ir_7151.pdf)

[2] 10-Print Capture Scanner & Software Requirements Workshop, User Group (DHS, DOS, DOD, FBI, NIJ, NIST), October 2005, (http://www.itl.nist.gov/iad/894.03/pact/10pWS/10pWS01-Agenda_etc.pdf)

Questions and Answers

I/O Software, Inc.

6711 Lee Hwy, Suite #214

Arlington, VA 22205

T: (703) 738-9267

F: (703) 852-7914

www.iosoftware.com

info@iosoftware.com