Auto-Capture Using Multi-Sampling

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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].*

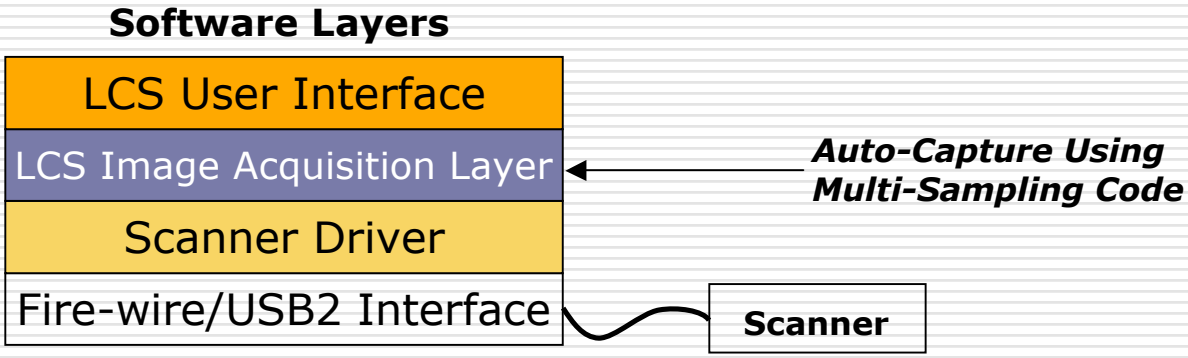
Improving fingerprint image quality starts at the point of capture

- *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.*

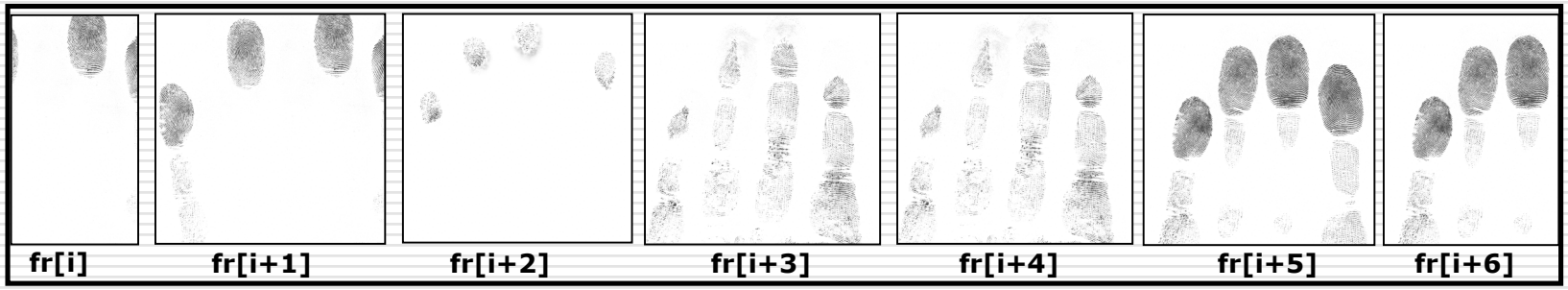
Auto-Capture Using Multi-Sampling

- 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



Multi-Sampling Process



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)

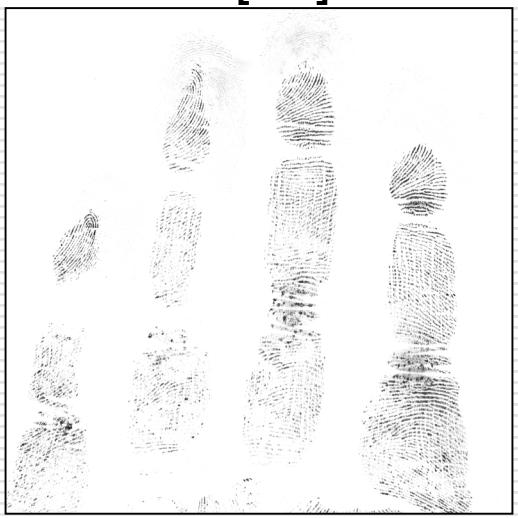
Sample Data Points

fr[i]

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

Failed Minutia Count!

fr[i+4]



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

Failed Slap Quality!

fr[i+6]

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

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

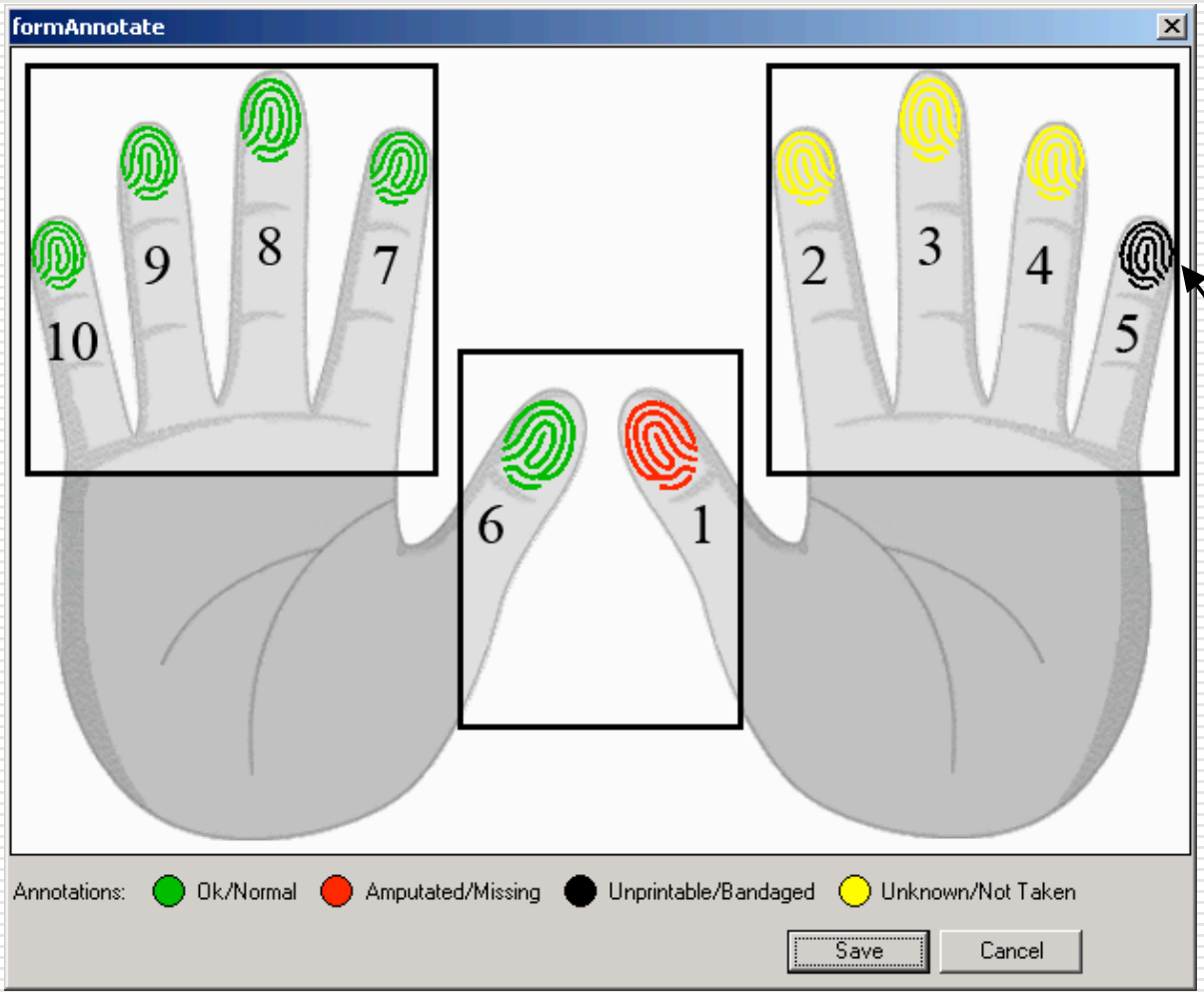
Blue border appears during auto-capture

Boxes drawn around segmented fingers after auto-capture

Override Functionality

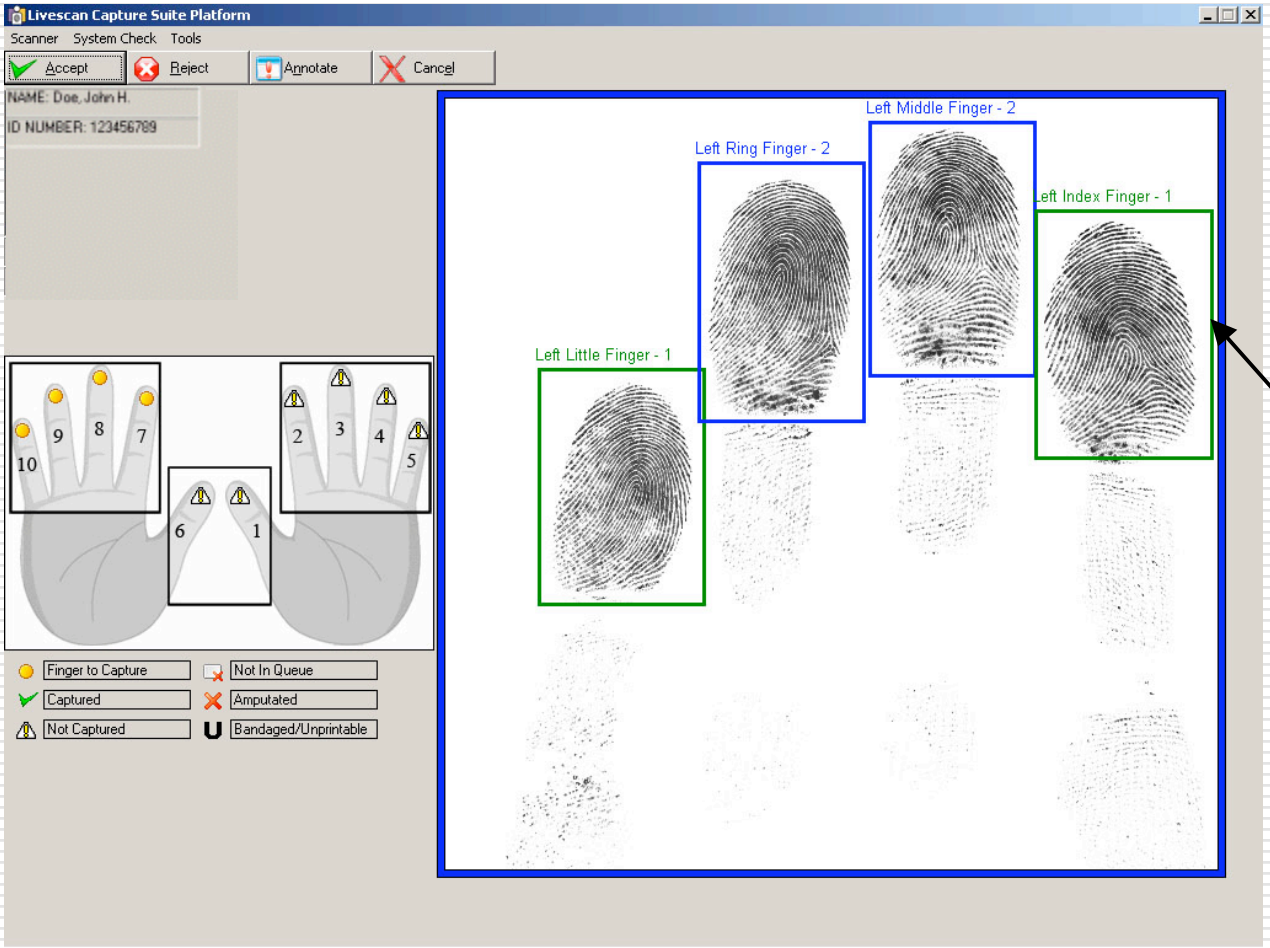
- Periodically, subjects have missing or badly damaged fingerprints.
  - Multi-sampling accepts quality images with missing fingers
  - Annotation tool can designate fingers as amputated or 'unable to print' before and/or after auto-capture
- Multi-sampling process will eventually force capture if no 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



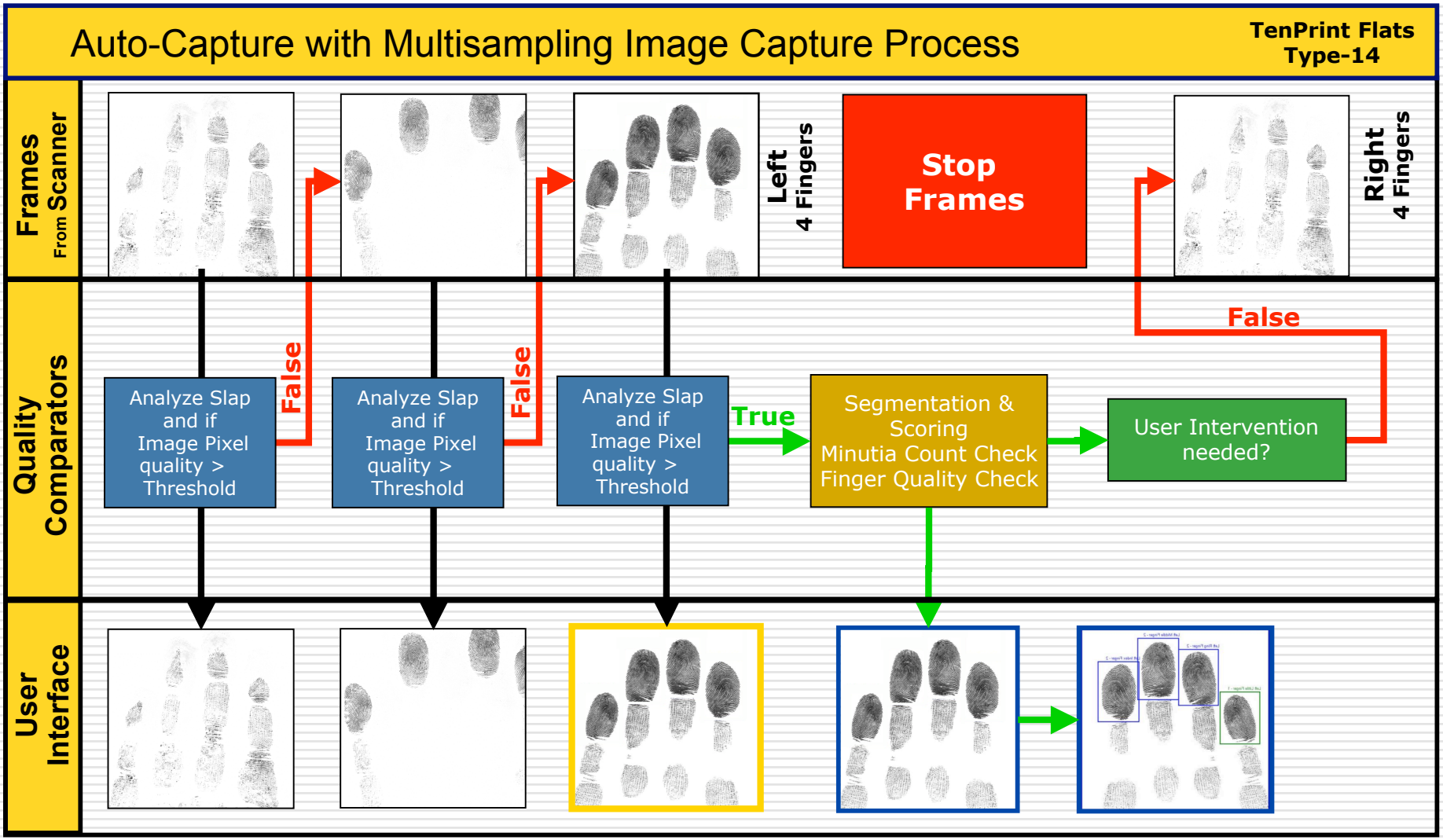
Finger can be designated as amputated or unprintable before or after auto-capture

Moveable Segmentation Boxes



Segmentation boxes can be manually resized after auto-capture

Multisampling Capture Process Overview



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

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