Improving Fingerprint Capture using "Auto Capture"

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Overview for Auto Capture

• Motivation
• Overview
• Testing Process
• Testing Results
• Testing Issues
• Further Work
Market Motivation

- **Kiosks**
  - Environments where there are no operators
- **Untrained Operators**
  - New Employees
  - New Equipment
  - New Application Contexts
- **Busy Operators**
  - Multitasking Roles
  - Migration from Capture to Quality Control
Technical Motivation

• Objective Decision Framework
  – People are not consistent
  – People get tired
  – People get distracted

• User Selection Latency
  – Quality Decision Time (200-400 msec)
    Often slower than the image frame rate
  – Software User Interface Latency (200-300 msec)

• Best Image Frame Possibility
  – Auto capture allows the possibility to examine all the image frames, and select the “best” one

• Potential for adaptive cost function
  – Under significant load, the time may be more important than the quality
  – Under light load, the objective function can heavily emphasize the best quality
Description

- The Auto Capture process is composed of several sub processes…
Sample Capture

An imaging system takes a series of “photographs” at a given frame rate.

Depends on many factors:
- Sensor Electronics
- Capture Time
- Sensor Dynamic Range
- Image Resolution
- Platen Size
- Imaging Size
- Computer Interface
Rapid Segmentation

- Driven by flats capture requirements
- An image must be classified into background and friction ridge regions
- Friction ridge regions must be classified into fingerprint areas and “other” areas
Rapid Quality

- Fingerprint regions must be assessed
  - Size
  - Shape
  - “signal to noise”

- This must be done on a frame by frame basis for each fingerprint
- NFIQ is currently not feasible for rapid quality
  - Extraction Time
  - Quality Issues
Decision Model

- Stable Frame Quality
- Peaked Finger Quality
- Cost Function
- Cross Finger Quality
- Pinky/Ring Weighting
User Interface

- Frame Speed
- Indicator per Finger
- Display Placement
- Local Scanner Feedback

Sample Capture

Rapid Segmentation

Rapid Quality

Decision Process

User Interface
Raw Fingerprint Images

Notice the long right ring finger
Raw Fingerprint Images

A fairly typical left slap
A Typical Fingerprint Capture
Testing Process

• User Selection
  – Poor fingerprints remain poor, regardless of operator or auto capture…
  – Good fingerprints are easy to capture

• Data to Collect
  – NFIQ Quality Scores
  – Capture Times
  – Operator, Observer, Kiosk

• Data Collection Process
  – 1 user at a time (no ~training)
  – Caller
  – Recorder (6 finger scores, 1 time)
  – 27 Subjects
Testing Results

Type 14 Slap Capture

Seconds

OpTime
QaTime
Self Time
Testing Results
Issues

• Hand Detection (Rotation)
• Segmentation Issues
• Platen Material
  – Latents
  – Dry Prints
• Training
  – Tips, Full Fingers
  – Pressure
NFIQ Issues

• Fingerprint Tips (Tips of Tips)
  – They get very generous scores

• Granularity
  – Only 5 levels of granularity, and there was not many fingerprints below a 3.
The Tips....
Future Work

• More People
  – More Expert Operators
  – More Novice Operators
  – More Applicants
    • Good Fingerprint Quality
    • Medium Fingerprint Quality
    • Poor Fingerprint Quality

• Optimal parameters
  – Decision Block
  – Signal Processing Block

• Better Algorithms

• Better UI

• Suboptimal Equipment/Environment
  – Distracted Operators
  – Dirty Platens
Summary

• Auto Capture drastically improves capture speed
• Auto Capture can improve NFIQ quality scores for poor fingerprint placement issues (tips of tips)
• Auto Capture typically improves quality with “passive” operators
• NFIQ may not be the best tool to measure an auto capture process.
• Further work is needed