Biometric Standards, Performance, and Assurance Laboratory

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Fingerprint Image Quality Evaluation: Elderly and Younger Populations

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Problem

The problem of this study was to determine the impact that particular variables, namely age and moisture, had on the utility image quality (usefulness of an image from a system standpoint) of fingerprint images. Discussion of poor image quality issues regarding elderly fingerprints occurs in the biometric literature (Behrens, 2002, p. 2; A. J. Mansfield, personal communication, 2002; Buettner, 2001, p. 5; J. L. Wayman, personal communication, 2002; Jain, Hong, & Pankanti, 2000, p. 9; Jain & Pankanti, 2001, p. 44; Jiang, & Ser, 2002, pp. 1121-1122). These quality issues pose problems for fingerprint recognition systems during the enrollment, verification, and identification processes.

Purpose

The purpose of this study was to evaluate fingerprint images of two populations, elderly and college, in order to assess age and moisture as potential factors affecting utility image quality. Specifically, the examination of these variables was conducted on a population over the age of 62, and a population between the ages of 18-25, using two fingerprint recognition devices (capacitance, optical).

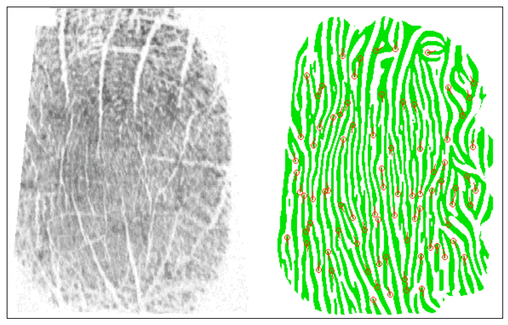

Figure 1. Fingerprint image and minutiae points of an 81 year old individual.

Figure 2. Fingerprint image and minutiae points of a 22 year old individual.

Image Quality

Two of the most common causes of poor utility image quality are attributed to non-uniform and irreproducible contact, which occur between the fingerprint and the platen of a fingerprint sensor. Non-uniform contact can result when the presented fingerprint is too dry or too wet, and irreproducible contact occurs when the fingerprint ridges are semi-permanently or permanently changed due to manual labor, injuries, disease, scars or other circumstances (Jain, Hong, Pankanti, & Bolle, 1997) such as loose or wrinkled skin. Due to these contact issues, false minutiae points are prone to be introduced into the captured image, causing higher FTE, FTA, FMR, and FNMR, thus reducing the performance of a fingerprint recognition system. Sample fingerprint images, along with minutiae points, collected from an elderly individual (81 years old) and a college student (22 years old) are shown in figures 1 & 2, with the resulting quality scores of the same images depicted in figures 3 & 4, respectively.

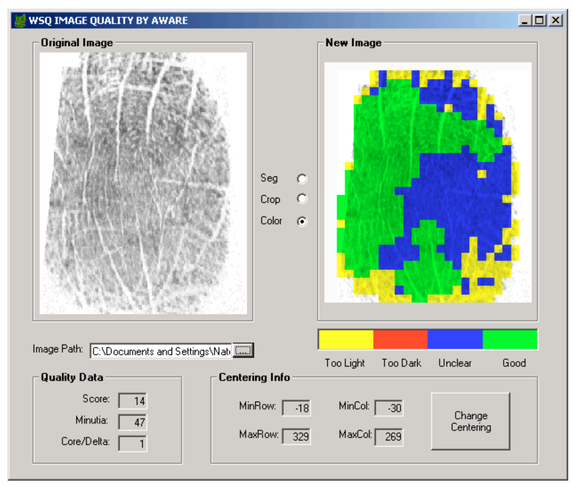

Figure 3. Simulated utility quality score of an 81 year old - score was 14/100.

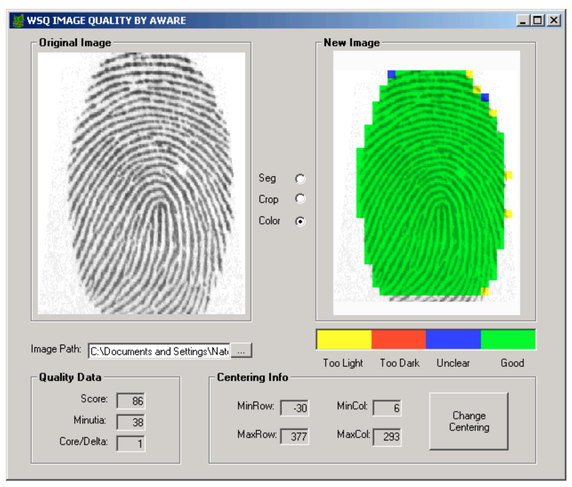

Figure 4. Simulated utility quality score of a 22 year old - score was 86/100.

Results

Table 1. Image Quality and Age ANOVA

	Right Index	Left Index
Capacitance	F value = 100.16 p value <.0001*	F value of 116.75 p value <.0001*
Optical	F value = 180.44 p value <.0001*	F value = 203.89 p value <.0001*

* Significant at $\alpha = 0.01$

The study examined two hypotheses, the first stated that there is no statistically significant difference in the fingerprint quality between the age groups 18-25 and 62+, and the second is that there is no statistically significant difference between the fingerprint moisture content of the age groups 18-25 and 62+.

The results shown in Table 1 indicate that age does affect image quality, regardless of device or which index finger was used. Therefore, the first hypothesis is **rejected** at $\alpha = 0.01$. The results shown in Table 2 indicate that moisture is also affected by age, however the results from the left index finger being used on the capacitance device failed to be significant, therefore only 3 of the 4 instances were **rejected** in hypothesis 2 at $\alpha = 0.01$. Graphical representations of the results are shown in Figures 5 & 6, with the correlation being -.78 and -.38, respectively.

Table 2. Moisture Content and Age ANOVA

	Right Index	Left Index
Capacitance	F value = 9.10 p value <.0032*	F value of 2.93 p value <.09
Optical	F value = 18.22 p value <.0001*	F value = 10.13 p value <.0019*

* Significant at $\alpha = 0.01$

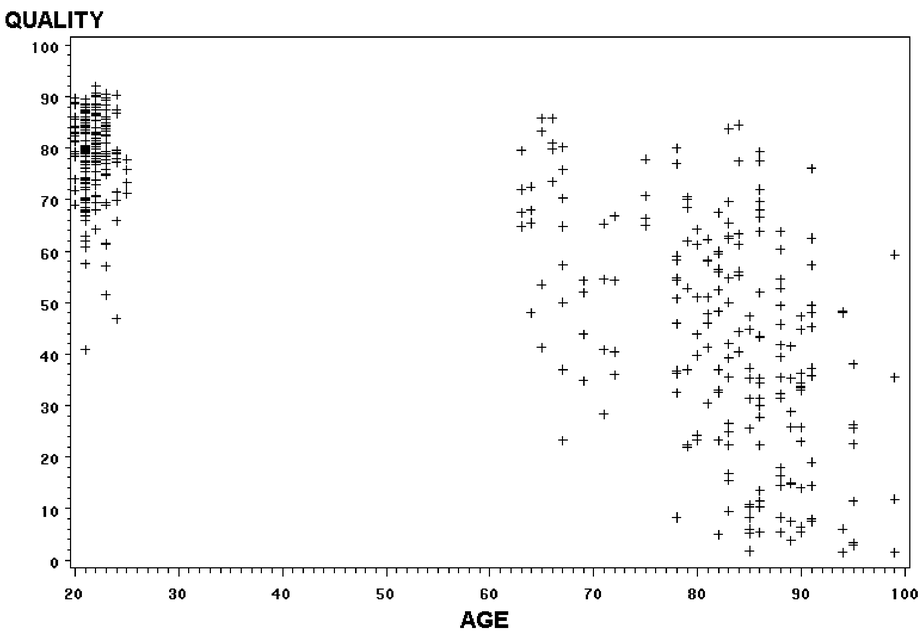

Figure 5. Plot of Quality Scores against Age.

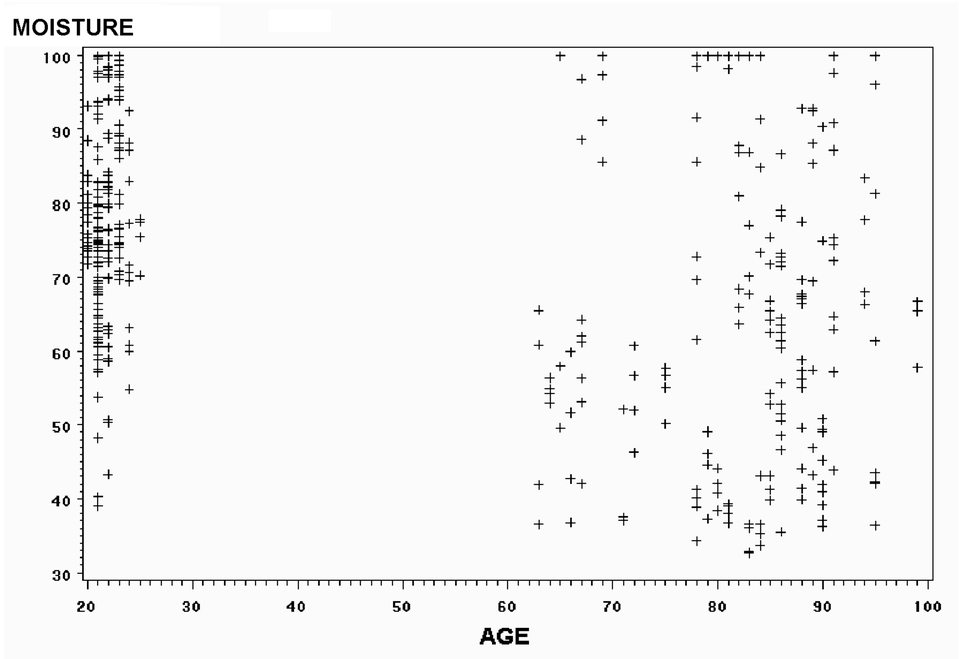

Figure 6. Plot of Moisture Content against Age.