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WSQ COMPRESSION / DECOMPRESSION

ALGORITHM TEST

REPORT

January 1994

PRETEST PRESUMPTIONS

1. ANSI will (or has) established the 500 x 500 pixels per inch by 256 levels of gray as the standard for transmitting electronic fingerprint images.

2. The FBI will (or has) established the WSQ Algorithm as the standard for the compression/decompression of electronic fingerprint images.

3. The WSQ Algorithm Compression/Decompression setting has not been established. Testing must be conducted before the compression/decompression setting can be established.

TEST OBJECTIVE

TO DETERMINE THE WSQ COMPRESSION/DECOMPRESSION ALGORITHM SETTING THAT WILL PROVIDE AN ACCEPTABLE COMPRESSED/DECOMPRESSED ELECTRONIC FINGERPRINT IMAGE THAT WILL SATISFY THE NEEDS OF THE FORENSIC SCIENCE COMMUNITY.

TEST METHODOLOGY

100 fingerprint cards were used in the test. Four rolled fingerprints from each card were selected for the test. The four fingerprints were scanned and recorded at 500 x 500 pixels per inch and 256 levels of gray. Each one of the four fingerprints were randomly compressed at settings of 5:1, 10:1, 15:1, and 20:1 - totaling 400 rolled fingerprints. Approximately 100 fingerprints were compressed/decompressed at each of the compression settings.

The fingerprint cards were obtained from the Illinois State Police AFIS benchmark test. The fingerprint cards contained fingerprints obtained from both male and female subjects. The fingerprint pattern types used in the test contained a sampling of all fingerprint pattern types. The fingers used in the test consisted of approximately 40 rolled fingerprints from each of the 10 fingers. The quality of the test fingerprints ranged from poor to good.

The 400 test fingerprints were decompressed and printed on a split screen format. The image on the left was an uncompressed image and the image on the right was the compressed/decompressed image of the same finger. There were no markings on the split screen images to indicate the compression setting. The only marking on the split screen images was the test print number.

Two highly experienced and competent latent print examiners were each provided with a test set of 400 split screen images. Each split screen image contained a test number from 1 to 400. The examiners were provided with a fingerprint image evaluation Form. Each examiner independently compared the standard image (uncompressed) with the compressed/decompressed Image to determine any differences between the standard image and the compressed/decompressed Image. Each examiner recorded his findings on the evaluation form by marking one of the three following evaluation codes for each test print:

TEST EVALUATION CODES

1. No noticeable reduction in image quality
2. Slight reduction in image quality which may interfere with an identification based on poroscopy, ridgeology, or other non-Galton details.
3. Noticeable reduction in image quality which may interfere with an identification based on the Galton details.

Only one evaluation code would be assessed far each fingerprint evaluated. if a test print contained a combination of Code 2 and Code 3 observations, Code 3 was used to evaluate the test print. When an evaluation Code 3 was assigned to a test print, the examiner highlighted the minutiae area on the test print and recorded the observation on the test evaluation form. When an evaluation Code 2 was assigned to a test print, the specific problem was recorded on the test evaluation form.

Upon completion of the test, each latent print examiner turned over the completed test evaluation forms to the test coordinator. The test results were tabulated and a post-test review was conducted between the test participants and the test coordinator. Differences of opinions were resolved and the test conclusions were finalized.

COMPOSITION OF TEST FINGERPRINTS

BY SEX:	MALE: 344(86%)	FEMALE: 56(14%)
BY PATTERN TYPE:	WHORLS:	115 (29%)
	LOOPS:	260 (65%)
	ARCHES:	25 (06%)

BY FINGER NO:	Finger #1	39	Finger #6	40
	Finger #2	41	Finger #7	40
	Finger #3	40	Finger #8	40
	finger #4	41	Finger #9	43
	Finger #5	39	Finger #1O	37

BY COMPRESSION SETTING:

5:1	101	15:1	101
10:1	100	20:1	98

TEST RESULTS

TEST EXAMINER #1

COMPRESSION SETTING	5:1	10:1	15:1	20:1	TOTAL
RESULT CODE #1	101	100	98	8	307
#2	0	0	3	90	93
#3	0	0	0	0	0
TOTAL	101	100	101	98	400

TEST EXAMINER #2

COMPRESSION SETTING	5:1	10:1	15:1	20:1	TOTAL
RESULT CODE #1	101	100	97	29	307
#2	0	0	4	69	93
#3	0	0	0	0	0
TOTAL	101	100	101	98	400

COMPOSITE RESULTS BY RESULT CODE

COMPRESSION SETTING	5:1	10:1	15:1	20:1	TOTAL
RESULT CODE #1	202	200	195	37	307
#2	0	0	7	159	166
#3	0	0	0	0	0
TOTAL	202	200	202	196	800

COMPOSITE RESULTS BY COMPRESSION SETTING

RESULT CODE		1	2	3	TOTAL
COMPRESSION SETTING	5:1	202	0	0	202
	10:1	200	0	0	200
	15:1	195	7	0	202
	20:1	37	159	0	196
TOTAL		634	166	0	800

OVERALL TEST CONCLUSIONS

The test did not reveal any degradation of Galton details in any of the test fingerprints. In a large number of fingerprints compressed at the setting of 20:1, some blurring of ridge detail with some loss of pore and ridge edge information was observed. This problem could result in the failure to identify a latent print containing a minimum number of minutiae with thin and/or incipient ridges, pores and ridge edges needed to identify the latent print.

In an extremely small number of fingerprints compressed at a setting of 15:1, some ridge blurring and some loss of pore and ridge edge information were observed.

No degradation was observed of those test fingerprints that were compressed/decompressed at a setting of 10:1 and 5:1.

COMPRESSION SETTING TEST CONCLUSIONS

5:1 Compression/Decompression: No degradation of the fingerprint images was observed.

10:1 Compression/Decompression: No degradation of the fingerprint images was observed.

15:1 Compression/Decompression: In 7 (3.4%) of the 202 fingerprint images reviewed, blurring of same ridge detail with some loss of pore and ridge edge information was observed.

20:1 Compression/Decompression: In 159 (81.1 %)of the 196 fingerprint images reviewed, blurring of some ridge detail with some loss of pore and ridge edge information was observed.

RECOMMENDATIONS

- That the WSQ algorithm with the compression/decompression setting of 15:1 be used for the transmission and storage of electronic fingerprint images.

- That the 20:1 compression/decompression setting be rejected from consideration for use with electronic fingerprint images at this time.

The WSQ algorithm is new and with additional refinement, the 3.4% degradation observed at the 15:1 setting may be corrected to the 0% degradation observed at the 5:1 and 10:1 compression/decompression settings.