Summary of the June 3, 1993, Compression Review Group Meeting

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In compliance with Motion #1 of the NIST Workshop on the Electronic Exchange of Fingerprint Images held on March 4-6, 1992, the fourth meeting of the Compression Review Group was held at NIST. This meeting took place in Gaithersburg, MDon June3, 1993. Organizations represented were the FBI, UK Home Office, IAI, NIDL, and NIST. Nine individuals were present including three from the Latent Fingerprint Section of the FBI.

Tests are currently being planned by the Latent Working Group at the FBI to examine displayed images for the purpose of investigating scanning resolutions and compression ratios as relates to image quality. In order to give members of the Compression Review Group an opportunity to review output images from the WSQ algorithm, a demonstration of this algorithm has been scheduled for June 23, 1993, at the FBI. Original images and the reconstructed versions of the compressed images will be displayed on the monitor so that any differences between the images can be observed.

Los Alamos and NIST are independently developing encoder and decoder implementations of the WSQ algorithm. Both of these implementations are extensions of the original WSQ algorithm developed at the FBI. In addition to the compression algorithm itself, these implementations will address several format variations described in the February, 1993, version of the "WSQ Gray-Scale Fingerprint Image Compression Specification". Within the next few months these implementations are expected to be completed and test images will be exchanged between the two organizations. Comparisons of the outputs of the encoder and decoder portions of the two implementations will be performed to validate the implementations.

When this testing phase is concluded, a notice will be placed in the Commerce Business Daily (CBD) inviting commercial vendors to participate in the testing procedures. These vendors will be able to ex-

change images among themselves, Los Alamos, and NIST. Successful completion of this testing will insure that images exchanged between agencies can be properly decompressed and that they conform to the Compression Specification. Details regarding conformance and testing for compliance, and issuing certification of WSQ implementations remain to be fully determined at a later date.

The WSQ framework was chosen as the compression technique to be used so that variations of the algorithm, based on the same general framework, could be developed in the future to provide better compression performance with the same or improved image quality. At this time there is only one member of the WSQ family which has been identified as being appropriate for fingerprint image compression. The Los Alamos and NIST implementations are based on this approved member. After this variation of the WSQ framework has been optimized for performance and quality, additional wavelets will be investigated for improved performance and image quality.

This approach is intended to put one approved compression algorithm in place and then to develop and approve additional variations based on the same family framework. Each variation of the algorithm will have computational details unique to that framework member. Since all variations are based on the same general framework, compliant decoders will have the capability and responsibility to accurately decode and reconstruct fingerprint images encoded with any of the approved family member encoders.

The target compression ratio for the rolled finger box is 20:1. Scanning images of 1.5” by 1.6” will usually include a considerable amount of white space surrounding the actual ridge structure of the image. This white background can be more efficiently compressed than the ridge structure. Therefore, the target compression ratio may be approached by compressing the white area more than 20:1, even though the ridge structure will be compressed at less than 20:1.

The overall desired compression ratio varies from image to image determined by values calculated from the information content of each image to be compressed. By using this technique to achieve a separate overall compression ratio for each image, the resultant compression ratio from all images should approach 20:1.

The image quality of reconstructed output images will be dependent on the quality of the input. The decompressed output from a poorly inked impression can never have abetter level of image quality than the input. The scanners used to input images will have a strong impact of the output. In the future, scanned images will originate from AFIS scanners, card scanners, and live-scan equipment.

The key ingredient to obtaining well compressed and high quality images is the use of good scanners and other equipment which satisfy the requirements for fingerprint identification. Recently, a new version of the Image Quality Specification for equipment was released by the FBI. This document states the engineering specifications that scanners and other equipment must meet or exceed in order to produce images which are acceptable to the FBI.

The main criteria for scanners is the Modulation Transfer Function (MTF) rather than line-pairs per millimeter, as was used in the past. The MTF method checks the performance of a system by measuring the response of the system at all lp/mm ratings between low and high values of lp/mm. As a more complete and comprehensive approach to measuring behavior, it is a curve of values taken at various lp/mm. As a result, MTF provides a better characterization of system performance than obtainable using a single-value of lp/mm. However, it may require specialized hardware and software to perform the analysis. On the other hand, checking the MTF response at a single value of lp/mm selected near the upper limit of the system response curve provides a method of evaluating performance based on visual observation. It is expected that the response at smaller values of lp/mm would be better than this, but the actual values are not determined. Using the MTF obtained at a high value of lp/mm should insure good performance at the lower values.

Scanners that adhere to the provisions of this specification should be able to capture high-quality data which will result in high-quality images being electronically stored.

The last part of the meeting was a demonstration by NIDL of the concept for an “electronic loupe”. This is an electronic device which, when developed, will provide the fingerprint examiner with the added ability to view electronic fingerprint images at a 1:1 scale. By mimicking the optical loupe, the “electronic loupe” will display side-by-side images in an environment familiar to the fingerprint examiner. The

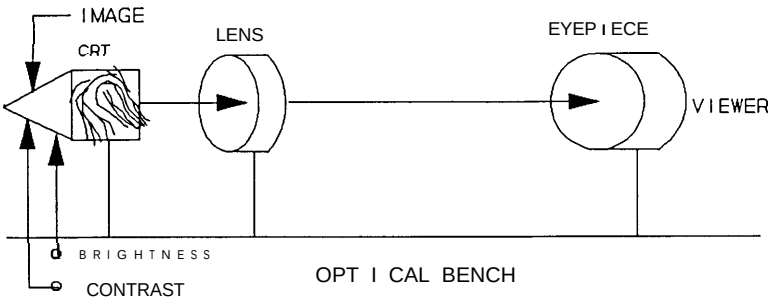

Figure 1

demonstration was enthusiastically received by the group and it was decided that this concept should be further developed.

The apparatus used for this demonstration was a "bread-board" model of the device. The intent of this model was to show the feasibility of the concept. In a final form, the "electronic loupe" will be packaged in a much smaller housing resembling the optical loupe, or, it could be built into the surface of a desk.

Figure 1 illustrates the "bread-board" model as demonstrated to the group which uses an optical bench to mount a miniature CRT, a lens, and an eyepiece that had been removed from an optical loupe (fingerprint magnifier). A fingerprint scanned at 500 by 500 was displayed on the miniature CRT with a resolution of 640 by 480. The display area on the CRT was approximately .5" x .5". The image from the CRTS focused on the lens and then to the eyepiece. A fingerprint examiner views the image through the eyepiece at the same size as if a fingerprint card was being examined. By means of control knobs, brightness and contrast levels of the image could be adjusted. Although a small CRT was used for this "bread-board' model, there are other display devices that could be used for side-by-side display including a larger CRT with a one thousand pixel per line display, or a liquid crystal display.

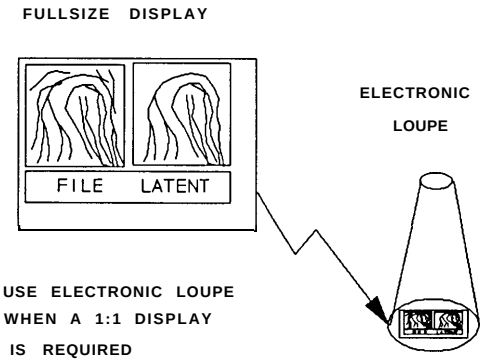

Figure 2

Side-by-side images magnifiedto 5:1 or greater and displayedon full size monitors are usually completely adequate for ten-print examinerstoperform their identification comparisons. However, attimes, the latent examiner needs to compare similar details oftwo images froma much smaller area of interest than the total fingerprint image provides. For these occasions, use of a full size display does not allow the examiner to make this comparison in a familiar setting. A tool to display those details in the same manner as available with an optical loupe would be quite valuable. The "electronic loupe" is intended to fulfill this function.

Figure 2 illustrates the planned use of the "electronic loupe". A fill size monitor simultaneously displays a latent image and a file image. Many of the identification characteristics can be located on this display. When additional detail is required, the same images can be viewed at a 1:1 display on the "electronic loupe". This will provide the examiner with a means of accurately focusing on details of interest from both the file and latent images.