Digitizing Document Examinations

A Poster Prepared by

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Objectives of the Project:
The Indiana State Police and Indianapolis-Marion County forensic laboratories are collaborating with the Institute for Forensic Imaging to add digital imaging capabilities. Questioned document examination is among the first applications to be addressed. To assure that the systems will meet the needs of the users, the Institute determined the basic workflow patterns of the expected users. This information was used to create two simulated cases – one very simple, and one moderate. In addition, an active case, involving a significant amount of material was digitized. The examiners worked in the Institute's laboratory and analyzed these cases to determine strengths and weaknesses, and to help set system requirements.

Key Factors and Approaches Considered:
The key factors considered included the capabilities of the image capture devices, the image viewing apparatus, the software suite, the data management approach, and the printing complement. The key issues considered included: resolution, processing time, and flexibility.

Results:
Image Capture: After testing several documents it, was found that a flatbed scanner probably would be the main capture device. We used a Hewlett Packard ScanJet 4C scanner. Detailed comparisons indicated that operating at 450 pixels per inch (ppi) in a monochrome mode would most likely suffice for 90% of the anticipated workload. At this resolution, the system records about 10 to 15 pixels across a typical ballpoint pen line. This proved enough to show gaps due to lack of ball inking and defects in the ball. This resolution will not, however, reproduce micro printing, which requires at least 600 ppi. There appears to be very little need to go above this. For simple position documents, 300 ppi is sufficient. Reducing the resolution at which a document is scanned saves both operating time and data storage space. The scanner has its limitations, however. It does not render items with surface texture or relief very well, tending to not capture the relief and to lose data that might be off the scanning surface. For these items and to capture high-resolution over small areas, the digital camera (about 1500 by 1000 pixels) provides excellent imagery (tests were with both a Kodak DCS 420 monochrome and a DCS 420 color camera). The camera can be used to show indented writing, raised or roughed surfaces, and buckling in the paper or substrate. Also, with proper lenses, the camera can be used to capture images of small areas of documents or type at very high resolution. In all cases involving color, a depth of 8 bits per channel was used. It was found that there is often a significant amount of information at both low-density levels as well as at high-density levels; for example, ball defects and ink distribution indications, respectively. Accordingly, one should be careful to preserve this type of information in setting the image capture parameters.

Image viewing: The examiners originally felt that the system would be used to capture and reproduce images, and that they would work with paper-based images. However, after some adjustments it became clear that examinations could be done "on screen". In some cases this affords advantages. The monitor used was a Sony Trinitron Mulitscan 20 sf II, which has 92 pixels per inch. The screen was set to 1280 by 1024 pixels. This setting has two major advantages: it made it easier to have several documents on the screen at the same time and it made the on-screen tool pallets smaller. At these settings it was possible to have two readable images of 8.5 by 11 documents on the screen at the same time. When examining handwriting style the four experts all tended to work at about twice life size. Detail analyses, such as ball marks, were done at higher magnification ratios. Layout issues were viewed at lower ratios.

Software Suite: There were five major components to the software suite. First, it was necessary to choose the operating system. Since the laboratories involved are already operating on a PC base, Microsoft Windows 95 was chosen. When more new device drivers become available, it might be useful to migrate to Windows NT, which is more stable and provides better security. Secondly, it is useful to have a multimedia database manager. Kodak QuickSolve (V 1.7.1) was used for this purpose because it has good search and good previewing capabilities. But, it is lacking the ability to send more than a single image at a time to another application environment. A new version (2.0) is due out soon, and it is hoped that it will provide a better interface. Third, for image enhancement and multiple-image viewing, Adobe Photoshop (V 4.0) was used. This software is broadly available, updated quite regularly, relatively inexpensive, offers a very wide range of native capabilities, and is easily customized through the addition of specialized "plug ins". It was found that the "Navigator" function in V 4.0 is particularly useful when viewing 8.5 by 11 documents on the screen but studying them at higher magnification. The "Actions" function is especially useful in keeping track of functions performed and in repeating the same functions on a series of images. Forth, it is useful to have a full functioned office suite installed. Microsoft Office was a convenient choice for our laboratory. Fifth, it is useful to have an OCR capability to create text documents to parallel typed documents. We used Caere OmniPro Plus because it is easy to use, robust, and compatible with the other elements in our system.

Data Management: It was immediately obvious that document images result in very large files. Accordingly, we recommend nothing less than 128 megabytes of memory. We used two 2-gigabyte hard drives: one for software, and the other for data. It is surprisingly easy to fill up these drives as one works a few projects at a time. For archiving of cases, we recommend use of serial numbered WORM CD's. We also used a 100-megabyte, removable media device to move information from one machine to another. The system should have a PC card reader for inputting images from the digital camera. Finally, the system should have a large capacity back up system.

Printing: The current recommendation for printer capability calls for both a color, dye-sublimation printer and a color inkjet printer. We used a Kodak 8650 printer and a Hewlett Packard DeskJet 870xi respectively. For some situations, it would be very nice to have a higher resolution, multiple bit printer as well, such as the Harris 500. However, such a device is beyond the cost parameters and not needed for most projects. Improvements in inkjet printers are expected in the near future, therefore, this printer recommendation could change. The dye sublimation printer gives excellent, photo-realistic images and can be used to support detailed analyses on enlargements. It can also be used to make court presentations. One way to do this is by parsing an image and pasting the several elements together to make a large board. Another, more simple approach, is to print an overhead slide. The current inkjet printer is quite satisfactory for production of working notes, position documents, and other low-resolution requirements.

Summary:
As a result of adhering to the work requirements of document examiners and having them work test cases, it was possible to design a digital system which should be a valuable asset to them in their future work. The system can save time since scanning is faster than photographing, processing, and printing by traditional methods. Also, since it is possible to assign retrieval data to images as soon as they are captured, they can be archived directly. The system facilitates easy capture of images, which can be analyzed in depth while the original documents go forward for fingerprint and/or other analyses. An important outcome of this work is the fact that documents could be readily analyzed on screen. In laboratories in which examiners check over each other's work, it is much easier to do such reviews on a large computer screen rather than off a piece of paper looking through a loupe.

N.B. The Institute for Forensic Imaging is a part of the Purdue School of Engineering and Technology at Indiana University, Purdue University-Indianapolis.
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