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Restoring Texts of Typewriter Ribbons: A Reliability Study of the RAW-1 Ribbon Analysis Workstation

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ABSTRACT: The ribbon analysis workstation (RAW-1) is a computer driven electro-mechanical device designed to enable specialists in questioned documents to transcribe and analyze any of a wide range of multi-row, single-strike, carbon film ribbons. The time consuming method of manually reading a single-strike ribbon makes the introduction of the RAW-1 a unique labor saving instrument. This study examines the accuracy of the RAW-1 in reproducing an accurate transcription of an original text from a carbon film ribbon. Ten single-strike ribbons, with a predetermined text of ten thousand words, were processed on the RAW-1. The texts from the ribbons were then compared to the printout from the RAW-1 for accuracy and repeatability.

KEYWORDS: questioned documents, computer, typewriter, ribbon, printer, laser printer, electro-mechanical unit

Questioned document examiners may spend many eye straining hours manually reading and transcribing texts from single-strike carbon-film typewriter ribbons. Methods of reading and/or transcribing these ribbons include using transmitted light, a micrographic reader, or videotaping the ribbon [*1,2*]. In 1989, Envisage Systems, Ltd., produced the Ribbon Analysis Workstation-1, commonly referred to as the RAW-1. The RAW-1 makes it possible to process and print out, in a readable format, a transcription of a full single-strike carbon-film ribbon in as little as one day. This process previously took weeks to accomplish manually.

The RAW-1 was developed in Great Britain, in close liaison with the Laboratory of the Government Chemist, the Metropolitan Police Forensic Laboratory, and the Home Office Forensic Laboratory (Birmingham, U.K.). This instrument is now manufactured exclusively by Envisage Systems Ltd, Watford, Herts, England. The RAW-1 is currently used by law enforcement and defense department laboratories in the United States, England, Canada, and Germany. The RAW-1 has reportedly been admitted as a scientific instrument in the British Legal System (personal communications, Envisage Systems Ltd., London, England, 1993). In December 1991, the Internal Revenue Service Criminal Investigation Division National Forensic Laboratory took delivery of a RAW-1.

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Communications with Envisage Systems Ltd. revealed that no systematic study had been undertaken to insure the RAW-1 reproduced the exact text of the typewriter ribbons that it scanned. The IRS National Forensic Laboratory felt it was important to conduct such a study in anticipation that the reliability of the instrument might be questioned by the United States courts.

How the RAW Works

There are three main elements to the RAW-1: the Electro-Mechanical Unit (see Fig. 1), the computer, and the printer. The Electro-Mechanical Unit is used to spool the typewriter ribbon in front of a "line scan" camera that captures the images on the ribbon. The computer controls the action of the Electro-Mechanical Unit and stores the captured data for processing and transcription. The printer generates the contents of the typewriter ribbon after it has been recorded. When an operator logs onto the RAW-1, he or she is offered a menu of operations. Each case is given a unique file number. After defining each ribbon, it is necessary to spool the ribbon from its spool onto a RAW-1 spool. When the ribbon is properly spooled, the operator sets parameters for the particular ribbon that is being processed, that is, the number of rows on the ribbon, height of the letters, and where the letters begin on the screen (see Fig. 2*a*). When the parameters are set, the ribbon is recorded. After recording the ribbon, the operator sets another set of parameters, which include horizontal and vertical settings, and "ignore windows" for areas of the ribbon that would interfere with character separation (see Fig. 2*b*). When the parameters are set and the text appears correctly on the screen, the operator sends the recorded text to the printer where the resulting transcript appears (see Fig. 3).

Method

The authors used a one thousand word generic text for the basis of the study. The text was entered on a *Gateway® 2000* 486-33 computer using the *WordPerfect®* word processing software. Checked for spelling errors, the original text was repeated ten times into one document file. Ten repetitions of the original document file were produced to make a total of ten individual files. Each file contained ten thousand words, for a grand total of one hundred thousand words. Each file was printed out on an *IBM® Wheelwriter 15 Series II* wordprocessor, using an *IBM Easystrike* ribbon and the results were numbered consecutively. The ribbons were then processed on the RAW-1. Each ribbon took approximately eight to ten hours to spool and scan into the RAW-1 system. The ribbon text printout using a *Hewlett Packard Laserjet II®* printer required an additional four hours.

The RAW-1 printouts were then visually compared to the original strike-up produced by the *IBM Wheelwriter 15 Series II* wordprocessor. The most laborious part of this project was the letter by letter comparison of the original typed strike-up to the RAW-1 *Hewlett Packard Laserjet II* printout.

To ensure that the test typewriter ribbons were processed consistently, one examiner processed all of the research ribbons.

Results

We found that, if the test typewriter ribbon was spooled with even tension and all parameters were properly set, the printout produced by the RAW-1 was in complete agreement with the typed research text. However, in running test ribbons and laboratory case ribbons, there are a number of factors that could cause less than perfect results if left unchecked. Initially, when the IRS National Forensic Laboratory received the RAW-

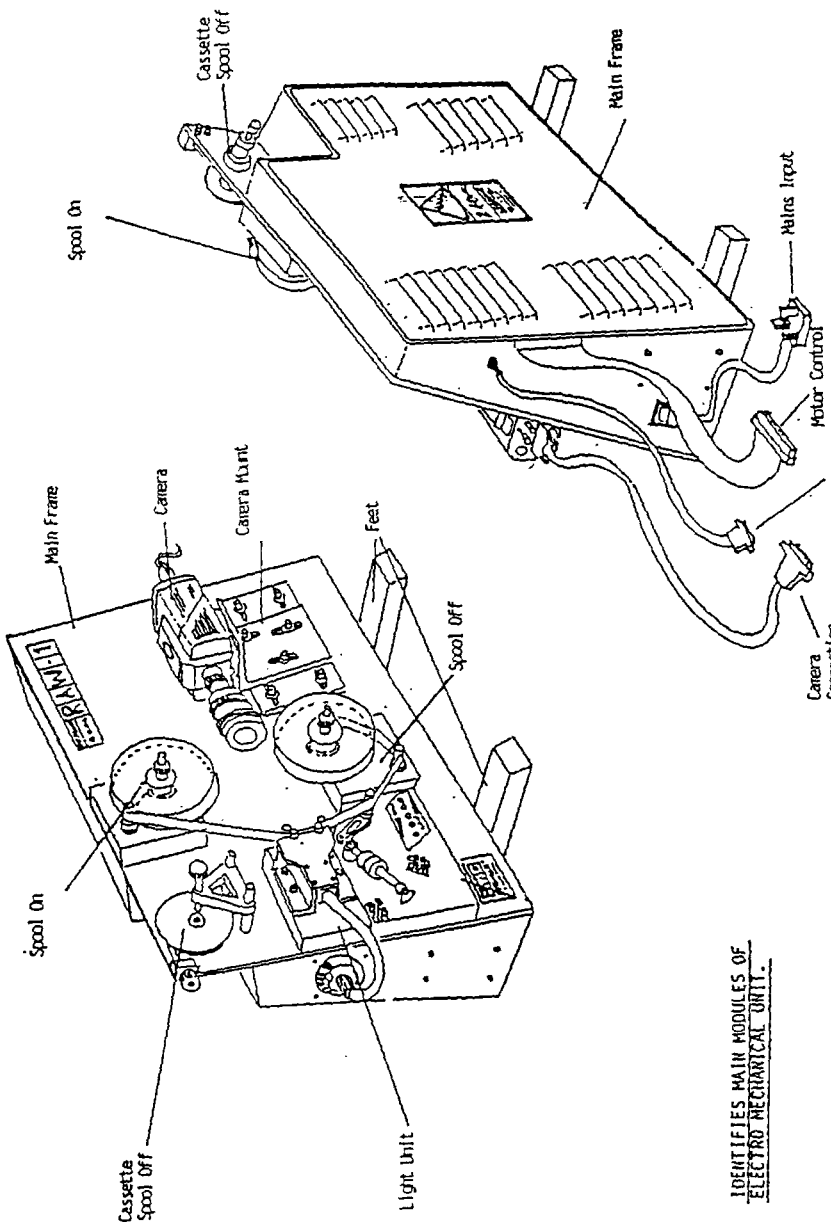
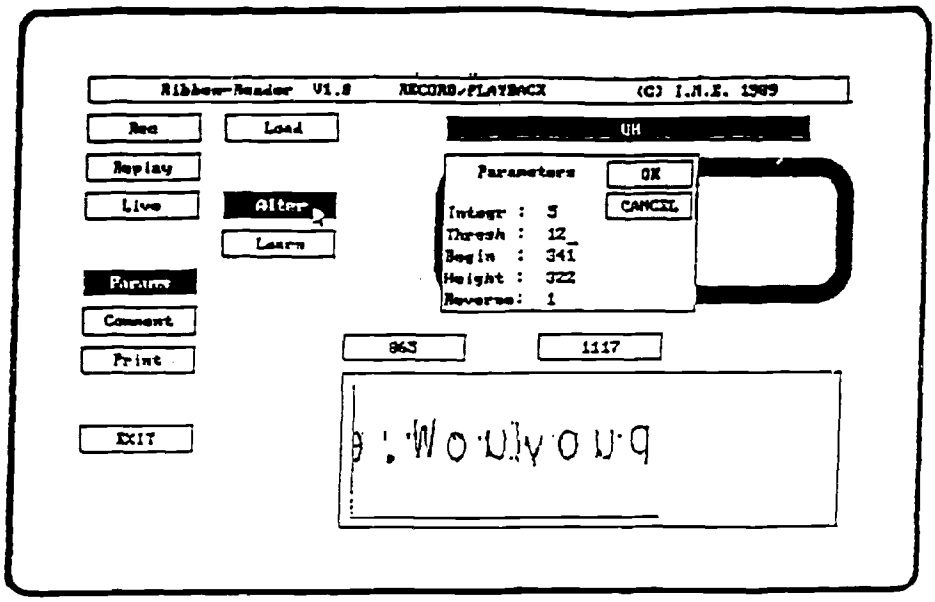
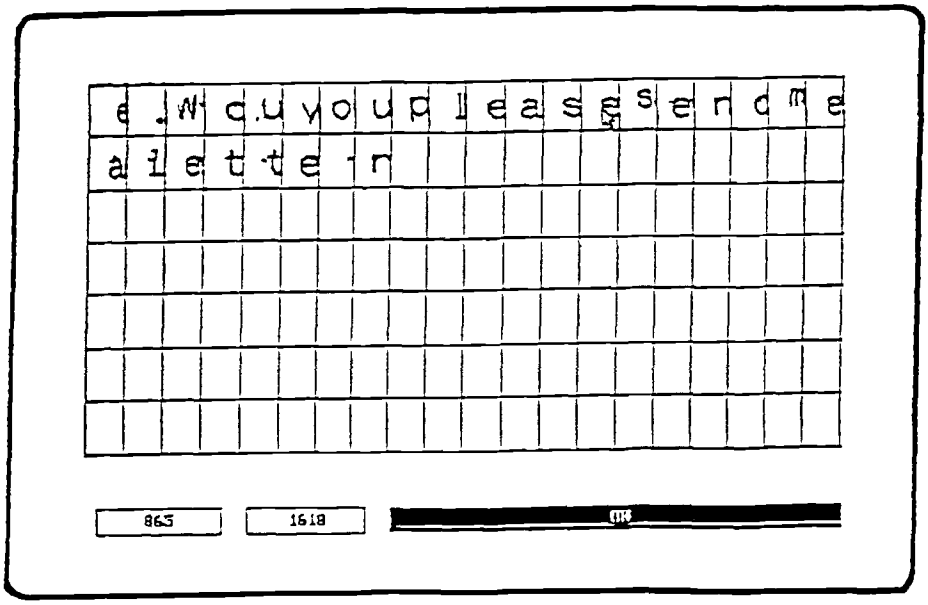


FIG. 1—*The elements of the RAW.*



COMPUTER SCREEN FORMING PART OF THE MOUSE DRIVEN OPERATOR INTERFACE



COMPUTER SCREEN OF SEGREGATED/SORTED CHARACTERS

FIG. 2—*Recording the ribbon.*

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(file: f:\rpn1-t10.img)                RAW-1 V1.5 Envisage Systems 1991
Operator:  rkh
    Date:  01/22/93
    Time:
    Case:  rpn1-t10
Case Ref:  rpn1
Evid Ref:
Cart Typ:  IBM Easystrike Correctable one row ribbon
Model No:  1380999
Manufact:  IBM
 Comment:


This text-segment starts at scanline-number : 699758


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districtoffices,10servicecenters,adatacenterandanationalc
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FIG. 3—*The transcript.*

1, the examiners found a slightly bent spindle that caused problems (such as uneven tension) with how the ribbon fed from the "spool-on" spindle to the "spool-off" spindle (see Figure 1). Envisage Systems, Ltd., immediately replaced the spindle. Since then the situations mentioned herein, have been due to either operator difficulties or problems with the ribbon itself, such as, poor quality ribbons. However, it should be noted, the operation of the RAW-1 does take some practice. The problems we encountered involved the following.

Spooling

This is by far the most important activity in running the RAW-1, and the process must be supervised at all times. The spooling command controls the tension of the ribbon. If

the tension is not even or is loose, the ribbon can slip during the scanning process. The authors found that the ribbon always slipped on the cassette "spool-off" section as the ribbon got smaller (see Fig. 1). If this slippage is not compensated for by tightening or adjusting the spool, differences in tension occur and problems may result.

Folds

When threading the ribbon from the "spool-on" spool to the "spool-off" spool, it is important that the spools are aligned evenly or the ribbon may fold upon itself (see Fig. 1). In extreme cases, this may prevent the camera from scanning. If left unchecked, the bottom spool will contain a folded mass of ribbon.

Uneven Tension

When the ribbon tension is extremely uneven, the RAW-1 might stop during the recording process. While this is not a major problem, the operator risks the loss of characters that were being scanned when the RAW-1 stopped. If the RAW-1 stops frequently during the scanning process, the information will be lost, and the operator must respool the ribbon and restart the scanning procedure.

Windows

Failure to properly set the windows (number of rows, horizontal and vertical parameters, "ignore windows," etc.) before printing the text can result in the truncation or splitting of letters. The improper placement of the "ignore windows" can cause characters such as hyphens not to show up on the printout. These difficulties are easily remedied by resetting the parameters until a satisfactory image occurs. It should be noted that in some cases it was impossible to eliminate all windowing difficulties, and an occasional split letter is therefore unavoidable. However, both parts of the letter will appear on the printout, making them still readable if this happens.

Periods and Commas

In reviewing the printouts, there were instances when the authors had difficulty distinguishing periods and commas. When the examiner is looking for an exact text of a printout, it might be necessary to consult the actual ribbon when examining small characters.

Poor Quality Ribbons

Poor quality ribbons present a problem which the operator cannot control. The ribbons utilized in this research project were good quality ribbons. However, the RAW-1 operators at the National Forensic Laboratory have encountered ribbons in case work which were scratched or damaged to such an extent that some characters did not scan properly. The printout from this type of ribbon is less than perfect. Damaged ribbons will cause the same difficulty to the examiner manually transcribing them. To date, we have not received a typewriter ribbon so badly scratched or damaged that we felt we couldn't process it on the RAW-1.

Conclusion

Since its introduction in the IRS National Forensic Laboratory, the RAW-1 has become a useful and time saving tool. As with any new piece of scientific equipment, acquiring proficiency takes time. The authors found in their research, when the typewriter ribbons were spooled with even tension, and all parameters were properly set, the printout produced by the RAW-1 was in complete agreement with the typed research text.

Acknowledgment

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