

Subject: RE: forensics problem
Date: Fri, 9 Sep 2005 15:00:11 -0500
Thread-Topic: forensics problem
Thread-Index: AcW0NFVQb4iOkotCQ8SKNDle5Jol9ABRHF4g
From: "Wong, Susan" <swong@hse.k12.in.us>
To: "Jan Allebach" <r1jan.p.allebach@wintek.com>
Cc: "George T. C. Chiu" <gchiu@ecn.purdue.edu>,
"Edward J. Delp" <ace@ecn.purdue.edu>
X-Greylist: IP, sender and recipient auto-whitelisted, not delayed by milter-greylist-2.0 (mail.wintek.com [199.233.104.76]); Fri, 09 Sep 2005 14:59:34 -0500 (EST)

Thanks so much to all of you for your help! I have attached the project that we are doing for "Constitution Day", Sept. 16th. To the attachment, I taped on the chart that you sent (I could not copy it off the PDF, so I had to cut and paste), before I made the copies. It was great material, and I look forward to seeing how their projects work out!

Thanks again, especially for the rush work, since I needed to get it out to my students today!

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-----Original Message-----

From: Jan Allebach [<mailto:r1jan.p.allebach@wintek.com>]
Sent: Thursday, September 08, 2005 12:14 AM
To: Wong, Susan
Cc: George T. C. Chiu; Edward J. Delp
Subject: forensics problem

Hi Suzy:

We were interested to know what kind of computational tools your students would be familiar with, and have access to in order to work on this problem:

1. Would they have calculators?
2. Would they have access to a PC?
3. Would they be familiar with Excel?
4. Would they be familiar with BASIC programming language?

Thanks,

--Jan

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Content-Type: application/msword;
 name="Constitution Day counterfeiters.doc"
Content-Description: Constitution Day counterfeiters.doc
Content-Disposition: attachment;
 filename="Constitution Day counterfeiters.doc"

Attachment converted: Titanium HD:Constitution Day cou#3483DA.doc (WDBN/«IC») (003483DA)

Constitution Day Project on Counterfeiters

Celebrated in 2005 on Friday, September 16; Honors Pre-calculus, Ms. Wong

Article I, Section 8, Clauses 5 – 6 Congress can coin money and punish **counterfeiters**.

October 12, 2004

Printer forensics to aid homeland security, tracing counterfeiters

WEST LAFAYETTE, Ind. – Researchers at Purdue University have developed a method that will enable authorities to trace documents to specific printers, a technique law-enforcement agencies could use to investigate counterfeiting, forgeries and homeland security matters.

The technique uses two methods to trace a document: first, by analyzing a document to identify characteristics that are unique for each printer, and second by designing printers to purposely embed individualized characteristics in documents. The technique currently focuses on laser printers but eventually will be expanded to inkjet printers, said [Edward J. Delp](#), a professor of electrical and computer engineering at Purdue. Findings of the research, funded by the National Science Foundation, will be detailed in three papers to be presented on Nov. 5 during the [International Conference on Digital Printing Technologies](#) in Salt Lake City. The papers were written by Delp; [Jan Allebach](#), a professor of electrical and computer engineering; [George Chiu](#), a professor of mechanical engineering; and engineering doctoral students Pei-Ju Chiang, Gazi N. Ali and Aravind K. Mikkilineni.

Counterfeiters often digitally scan currency and then use color laser and inkjet printers to produce bogus bills. Forgers use the same methods to make fake passports and other documents. "Investigators want to be able to determine that a fake bill or document was created on a certain brand and model of printer," Delp said. So far, the researchers have been able to successfully identify which model of printers was used to create certain documents in 11 out of 12 models tested, according to data to be released during the conference. Officials also would be able to use the method to determine the authenticity of documents, such as airline boarding passes and passports.

Such information would enable homeland security investigators to determine from what country or regions of the world certain printed documents originated, which could help trace the location of potential terrorists and their collaborators. The technique uses specialized software to detect slight variations, or "intrinsic signatures," of printed characters, revealing subtle differences from one printer to another. Even printers that are the same model have slight flaws and variations in their mechanical systems. These variations result in subtly different characters.

"This is a very competitive market right now. You can buy a color laser printer for less than \$500. One of the ways in which manufacturers are able to make printers so affordable is by cutting corners. The gears are made of plastic, and they are not made extremely accurately. There also is variability from toner cartridge to toner cartridge. Allebach and Chiu have been working with printer companies for more than five years to reduce a phenomenon called "banding," which are horizontal imperfections in the print quality of documents." "Banding arises whenever you have a print mechanism that uses rotating components," Chiu said. "What happens is the components don't necessarily rotate at an exactly constant speed." Inside of a laser printer's cartridge is a "photoconductor drum," which rotates as a laser beam scans back and forth along the drum. The drum is coated with a charged material that releases its charge when exposed to light. The laser turns on and off rapidly, selectively removing the charge in certain areas. Toner is attracted to those areas that no longer have a charge, forming letters or features of an image, which are then transferred onto sheets of paper. "This process is called development," Allebach said. "Because of variability in printers, the drum does not rotate at a constant speed. If the drum slows down a little bit as it is rotating, you get excessive development, so the print will look a little dark. And where the drum speeds up, you get too little development and the print will look a little bit light."

The resulting bands of light and dark cause imperfections in a text document or an image. Because every printer has its own unique pattern of banding, or intrinsic signature, the imperfections can be exploited to trace a document to the printer on which it was created, Chiu said.

"We extract mathematical features, or measurements, from printed letters, then we use image analysis and pattern-recognition techniques to identify the printer," Delp said. If, however, the printer cartridge is changed after a

document is printed, the document no longer can be traced to that printer. Banding can be altered from one printer to another by adjusting the laser intensity, how long each laser pulse lasts and the precise positioning of a small motor that steers the laser beam inside the printer.

The Purdue researchers are working with the U.S. Secret Service to develop new methods for tracing documents and counterfeit bills.

Related Web site:

[Purdue University Home Page](#)

A publication-quality photograph is available at <http://ftp.purdue.edu/pub/uns/+2004/delp-forensics.jpg>

Thanks to researchers, authors, and faculty at Purdue University, Jan Allebach, George T. C. Chiu; Edward J. Delp, we have some data for you to graph on your calculator, and one on which to do a linear and some other type of regression. Look at the plotted data on the scatter-plot and determine which other type of regression would produce a best-fit curve.

Each class period will work on a separate set of data. All will be related to the fiscal year and the independent variable. Then create a scatter plot of the indicated item for your class period. Complete all of the items listed on the page for your information, and answer all questions. The grading rubric is included. This project is due September 16th, the official Constitution Day for education.

The Use and Counterfeiting of United States Currency Abroad, Part 2

United States Treasury Department

The Use and Counterfeiting of United States Currency Abroad, Part 2

The second report to the Congress by the Secretary of the Treasury, in consultation with the Advanced Counterfeit Deterrence Steering Committee, pursuant to Section 807 of PL 104-132

March 2003



increased, as seen in table 6.8. Many inkjet-produced counterfeit notes are of lesser quality than notes produced on offset presses, but their quality is high enough to deceive many commercial establishments. In addition, as shown in the middle columns of table 6.6, the dramatic increase in the supply of inkjet counterfeits has led to a concomitant sharp increase in plant suppressions and related arrests. However, this phenomenon is not exclusively or even mainly a juvenile problem: in fiscal year 2001, only 20 percent of inkjet counterfeiting cases involved juveniles.

Table 6.8
Digital Counterfeiting Activity within the United States

Fiscal year	Digital notes passed		Plant suppressions			Arrests		
	Value, thousands of dollars	Share of total counterfeit notes passed (percent)	Total	Inkjet	Inkjet share (percent)	Total	Inkjet-related	Inkjet-related share, percent
1995	175	0.5	153	29	19	1,856	37	2
1996	760	3	198	101	51	1,737	176	10
1997	6,121	19	435	321	74	2,436	1,100	45
1998	17,050	43	616	547	88	3,569	2,618	73
1999	15,783	40	677	651	96	3,466	2,846	82
2000	18,460	47	551	527	96	3,467	2,998	86
2001	18,403	39	651	608	93	5,241	4,536	87
2002	15,639	36	555	528	95	4,366	3,734	86

Thus far, the problem of digitally printed notes is largely a domestic one, reflecting the fact that the United States has a knowledgeable and widely dispersed group of personal computer users. However, as the personal computer revolution moves worldwide, it is reasonable to predict that digital counterfeit usage will follow. In the wake of the terrorist attacks of September 11, 2001, the U.S. Congress, recognizing the threat to our nation's critical economic infrastructure posed by financial crimes, included the counterfeiting of U.S. currency in the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001.⁴⁴ On October 26, 2001, the President signed the act into law.

⁴⁴H.R. 3162