Finding Ways to Read and Search Handwritten Documents

Technologies for reading and searching digitized documents have helped academic researchers. However, no one has developed a truly effective engine that can work with handwritten documents, a potentially valuable source of information for many purposes. R. Manmatha, a research assistant professor with the Center for Intelligent Information Retrieval at the University of Massachusetts, Amherst, hopes to change this.

Handwritten documents are generally scanned as images of entire pages, not as individual characters that optical-character-recognition technology can recognize when searching for responses to queries. Current handwriting recognition systems generally work well only with documents that contain specific types of information written in a consistent format, such as addresses.

Thus, to read and search most handwritten documents, someone must type them up and create digitized versions, a costly and time-consuming process.

Manmatha's system scans handwritten documents as images. His research team first tried to match each written letter with a digital image of a letter. However, handwriting variations—such as letter height and slant—made consistent accuracy difficult.

Instead, Manmatha developed a system that examines entire words, which provides more context than individual letters for identifying written material. Using a statistical model, he explained, the system learns to associate images of words with actual words in a probabilistic manner and then stores this information in a database.

The system compares an image of a word with images it has encountered in the past to find a likely match. It then identifies the new image as the word associated with the likely match.

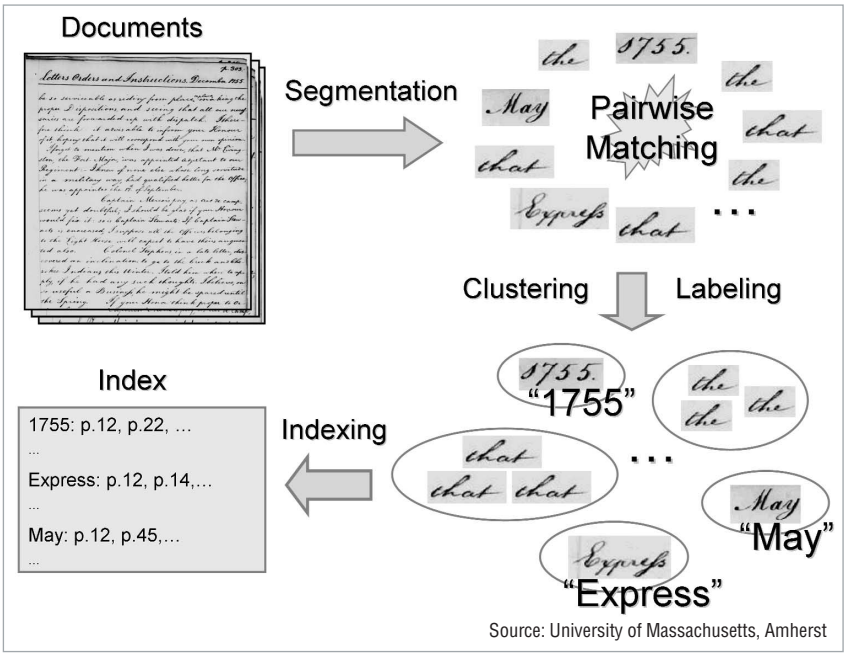
To develop their system, Manmatha and his students obtained about 1,000 pages of US President George Washington's correspondence that had been scanned from microfilm by the Library of Congress.

Even after training, the system's accuracy in identifying words ranges from 54 to 84 percent. Manmatha said refinements such as better image processing could make his technology more accurate.

And making the system faster, perhaps by developing more efficient algorithms, will be particularly important so that it can work with large collections of documents, he noted.

Chris Sherman, associate editor at SearchEngineWatch.com, noted that research on searching handwritten document has been taking place since the 1980s.

There seems to be a limited demand for this technology, Sherman said. "I could see this being used for scholarly archives going back to eras when there weren't computers, but I don't see it as being a huge application." ■



A University of Massachusetts researcher has developed a technique for reading and searching handwritten documents. The system works with a statistical model that learns to associate images of words with actual words in a probabilistic manner. The system first segments a document to obtain images of individual words. It compares the images with images it has encountered in the past to find a probable match. The system then identifies and tags the new image as the word associated with the likely match. It keeps these new identifications in an index for future reference.

A Gem of an Idea for Improving Chips

A US researcher is developing ways to use diamonds in chips to overcome some of silicon's limitations. Damon Jackson, a research physicist at the Lawrence Livermore National Laboratory, has used diamonds to house electronic circuitry.

Jackson's research team lays a 10- to 50-micron layer of tungsten film on a one-third-carat diamond, adds circuitry, then grows a single crystal layer of synthetic diamond on top of the tungsten so that the wires are completely embedded.

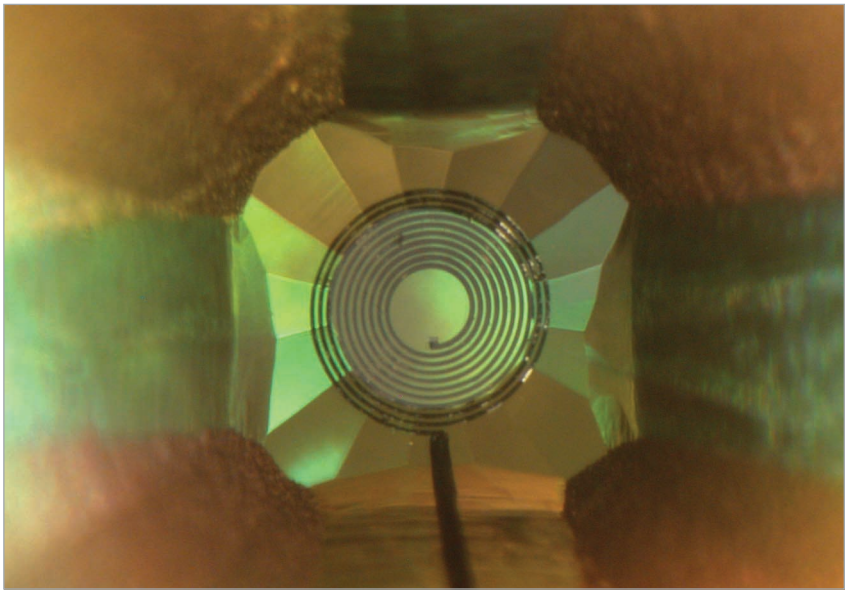
The research team uses diamonds because they offer advantages over silicon in strength and their ability to resist high temperatures, improve cooling by conducting heat away from the circuitry, and withstand high pressure and radiation.

This protection makes the system ideal for circuitry used in challenging environments such as space, Jackson said. Satellites, for example, experience considerable heat buildup, atmospheric pressure, and radiation.

However, there are significant obstacles to using diamonds in chips. First, diamonds are expensive, although widespread use in chips would eventually reduce the per-unit cost to some degree. Fabrication-related activities and research would also be costly, Jackson noted.

He is working with Yogesh Vohra, a physics professor at the University of Alabama at Birmingham who developed the chemical-vapor-deposition technique for growing industrial-quality diamonds by cooking methane, hydrogen, and oxygen gases in a very hot microwave oven.

The advantages of this method, Vohra explained, are that the raw materials are inexpensive, the process scales well, it's easy to embed wiring, and the diamond's electrical properties can be changed via doping. And as more businesses use diamonds in manufacturing, their price will drop.



Researchers have found a way to house electronic circuitry on a diamond. Diamonds have advantages over silicon in strength and in the ability to resist heat and withstand high pressure and radiation. This makes "diamond chips" ideal for use in challenging environments such as space.

At some point, Vohra said, researchers may even develop diamond-based circuitry.

Pushkar Apte, vice president of technology programs at the Semiconductor Industry Association, a US trade association, expressed doubt about using diamonds in chips, saying that silicon is already a well-established technology.

However, he added, "It may be used in some niche applications that demand thermal conductivity." ■

IBM Lets Open Source Developers Use 500 Patents

IBM has made 500 US software patents available royalty-free to open source developers. The patents cover 14 categories of technology, including e-commerce, storage, image processing, data handling, networking, and Internet communications.

"We wanted to give access to a broad range of patents," explained Marc Ehrlich, IBM's legal counsel for patent portfolio management. He said the patents represent "areas reflective of activity in the open source community," such as databases and processor cores.

IBM will continue to own the 500 patents but will allow fee-free use of their technologies in any software that meets the requirements of the Open Source Definition, managed and promoted by the nonprofit Open Source Initiative (www.opensource.org).

IBM, which has vigorously supported the open source operating system Linux, has expressed hope its action will establish a "patent com-

mons" on which open source software developers can base their code without worrying about legal problems.

Traditionally, IBM and other companies amass patents, charge anyone who wants to work with them, and take legal action against anyone who uses them without paying royalties. IBM has 40,000 patents worldwide, including 25,000 in the US. It has obtained more US patents than any other company during each of the past 12 years.

However, Ehrlich said, IBM has realized that letting open source developers use some of its patents without charge will allow them to expand on the technologies in ways that the company might never do on its own. This could benefit IBM and others, he explained.

IBM could create new products or services for a fee on top of open source applications that use its patented technologies, said Navi Radjou vice president of enterprise applications at Forrester Research, a market analysis firm. And, he said, selling versions of software that open source developers have based on its patents eliminates the need for IBM to pay its own developers for the new work.

In the process, Radjou noted, IBM's patent release lends credibility to the open source movement and gives IT departments more confidence in using open source products.

Because groups of independent developers create open source software, proponents sometimes have trouble knowing whether products include patented technologies. This could expose open source proponents and their products to legal action by patent holders. And finding patented software in open source products could force programmers to write new products and customers to switch to the new versions.

However, Ehrlich noted, sophisticated open source projects are starting to adopt practices to ensure that the code being used is free from patent-related problems.

He said IBM may give open source developers royalty-free access to more patents in the future and hopes other companies will do the same.

Businesses such as Novell and Linux vendor Red Hat have already either offered their technologies to open source developers or taken steps to protect users of their open source software.

"Unsurprisingly, the open source community thinks this is a good thing," said Eric S. Raymond, the Open Source Initiative's founder and president emeritus. "But the deeper message here is that IBM is saying by its actions that the patent system is broken. The top patent-holder in the US, the biggest beneficiary of the system, has concluded that the best way it can encourage innovation is to voluntarily relinquish its rights."

According to Raymond, this should "give pause to those who believe strong intellectual-property laws and IP enforcement are vital to the health of the software industry." ■

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Biometrics Could Make Guns Safer

An innovative biometric system could keep children, thieves, and others from firing guns that don't belong to them. New Jersey Institute of Technology (NJIT) professor Timothy N. Chang and associate professor Michael L. Recce are developing the new approach, which is based on authorized user's grip patterns.

In the past, researchers have worked with fingerprint scanners to recognize authorized shooters, and systems with tokens that users wear to wirelessly transmit an unlocking code to a weapon.

In the NJIT system, 16 tiny sensors in a gun's grip measure the amount and pattern of finger and palm pressure as the user tries to squeeze the trigger. "The system doesn't care how you pull the gun out of the holster or how you handle it when you are not actually shooting it," explained Donald H. Sebastian, NJIT's senior vice president for research and development.

Unlike the static biometrics found in fingerprint scanning, NJIT's system looks at a pattern of movement over time. Shooters create a unique pattern of pressure when squeezing a weapon while firing it. During the first tenth of a second of trigger pull, the system can determine whether the shooter is authorized to use a gun, according to Sebastian. If not, the system will not let the gun fire.

Sensors measure the voltage patterns the system's circuitry generates when a user tries to pull the trigger. The system then converts the analog signals to digital patterns for analysis by specially designed software.

All authorized users of a gun initially train the system to recognize the patterns they create when using the weapon. This information is stored for comparison any time someone tries to use the gun.

Currently, a computer cord tethers the gun to a laptop that houses the biometric system's software. However, Chang said, the team plans to move the circuits from the laptop into the gun's grip.

The system presently has a 90 percent recognition rate. Sebastian said this is not precise enough for a commercial system but "90 percent accuracy out of 16 sensors is amazing." The research team plans to use up to 150 sensors to improve precision and may add biometric palm recognition as a backup.

According to Sebastian, the technology may be ready for commercial release within three to five years. ■

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