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New ink may have the power to talk

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Ink has been used for millennia to convey ideas, but it may be about to convey something new: electricity.

Don't worry. This isn't about getting a shock off a printed page. Rather, its about making electronics cheaper - at a fraction of a cent - by replacing wires, circuit boards and batteries with ink.

A small, New York-based outfit called [T-Ink Inc](#) is pioneering the use of electrically conductive ink in ordinary printing presses.

"Our goal is a total print medium where your paper is going to talk," says Andrew Ferber, vice chairman at T-Ink and one of the brains behind the technology. He envisions newspapers that include printed loudspeakers, batteries and circuits.

For now, the technology is available in limited form and in somewhat trivial applications.

Conductive ink was used to print circuits on tray mats for Australian McDonald's. A light on a toy that came with meals lit up if it followed a maze-like circuit on the mat.

Also out from T-Ink is an inflatable radio with printed controls as well as a Clue game board that senses where the pieces are and plays sound effects - such as the sound of feet on gravel for someone near the stables.

Among other projects being considered: nappies with built-in wetness sensors, drug packaging for the elderly that reads the prescription out aloud when touched, light switches painted onto walls and clear security sensors painted onto windows.

The company is starting much of its early efforts on toys and promotions - "you might call them the low-hanging fruit for us," Ferber says.

Toys are designed and made quickly, while launching an industrial product can take five years. T-Ink also has the connections, formed two years ago by toy design and TV production group Abrams Gentile Group LLC and Ferber's outfit Colortronics. Not surprisingly, the privately held company's office in midtown Manhattan is stacked with enough toys to make any kid giddy.

T-Ink's use of conductive inks is innovative, but the basic idea isn't new. Engineers use pens with silver ink to improvise or repair circuits on circuit boards, for instance. And underneath the keys of computer keyboards are membranes with printed circuits that sense when a key is pressed. Windshield defrosters are also printed.

But those applications are mostly screen-printed, a slow and expensive process used because it leaves a thick layer of ink, much like the ink on an embossed business card. With new inks, offset printing and other faster technologies can be used as well.

Ferber is coy about the composition of the inks, but says T-Ink has moved beyond the materials used to make traditional conductive ink - particles of silver and carbon. T-Ink's patent applications describe using various mineral powders and some conductive plastics. The inks can come in any colour, and can be washable, too.

For all of Ferber's enthusiasm, conductive inks have drawbacks. Blue Ramsey, a researcher at Brunel University in England, has studied high-speed printing and points out that for one, conductive ink has more resistance than the copper used in traditional circuit boards. That means it can't carry a strong current efficiently.

Also, ink isn't very practical for making circuits that can do something smart, like performing a calculation. It isn't yet

possible to print circuits that are as dense as those in a silicon chip, so a printed calculator would have to be huge, probably one square metre.

"You need a fairly large area to do anything clever," Ramsey said.

Also, engineers have had trouble making a magnetic ink that is strong enough for a loudspeaker, meaning Ferber's goal of a talking newspaper is at least several years away.

T-Ink is close to printing batteries, Ferber says, but for now, his designers have to connect ink circuits to batteries, chips and speakers made with more traditional technology. Still, there's plenty that can be done with simple conductive ink, and the field has attracted competitors, including [Flint Ink Corp](#), the world's second-largest maker of inks.

"Printing conductive inks using high-speed printing processes would provide for huge cost savings," says Jim Rohrkemper at the Ann Arbor, Michigan company.

Flint Ink, which has 5000 employees, has set up a unit to develop methods of cheaply printing antennas for radio-frequency identification tags, the tiny chips that retailers are hoping will replace bar codes.

Widespread adoption of RFID tags is being delayed by cost. Though much of it is due to the chip, which can't be printed, printing the antenna part could help bring the total price down.

Others in the field include [Power Paper](#), an Israeli company that prints paper-thin batteries used by Hasbro in stickers that play music when pressed. Those batteries plus electronics cost 20 cents to a US dollar to make, too much for many applications. T-Ink believes it can undercut that price substantially.

Several companies, like Seiko Epson of Japan and [E Ink Corp](#) of Cambridge, Massachusetts, are working on printing bendable computer displays on paper - essentially computer monitors that you can roll up and fit in your pocket.

No one is trying to take the concept as far as T-Ink, however. It is even working on conductive ink that can be added to candy. The idea is to give pieces of candy differing electrical resistance, so an electronic game board can recognise them as different playing pieces. Presumably, the winner gets to eat the pieces.

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