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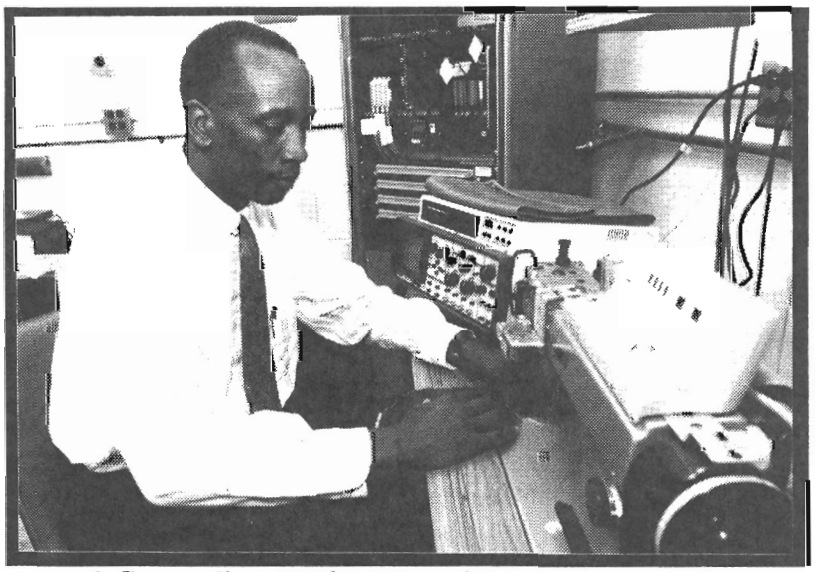
LISTENING FOR THEIR OWN MISTAKES: RESEARCHERS DEVELOP ELECTRONIC "EARS" FOR MONITORING AUTOMATED SEWING MACHINES

Researchers at the Georgia Institute of Technology are developing electronic "ears" that may help automated sewing machines of the future supervise their own work. The sensing devices would allow the next generation of sewing machines to detect problems before they cause defects in manufactured apparel.

The researchers' goal is to improve the quality and lower the cost of clothing by eliminating defects and reducing the amount of labor that goes into each item. Their work is part of a larger research program sponsored by the U.S. Defense Logistics Agency, which purchases uniforms and other apparel items for Defense Department agencies.



Bernard Gunn adjusts equipment used to measure acoustic energy produced by the needles of an industrial sewing machines. (Color/B&W Available).

Georgia Tech scientists already have demonstrated the feasibility of a device that would monitor the wear of sewing machine needles by listening to the sound made by the needles each time they pass through fabric. When the sound intensity reaches a pre-set level, the device would summon a human operator to replace the needle before it could damage the garments.

Other research goals include detecting misaligned fabric pieces, broken thread, improperly-set thread tension and even chipped or broken needles. Many of these quality control checks are now made by sewing machine operators, who would be eliminated from future automated assembly lines.

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FOR MORE INFORMATION:

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"In order to compete, you must reduce labor costs, so the apparel industry is in the process of automating much of what it does," noted Dr. Howard Olson, associate professor of textile engineering. "But when you take away the machine operator, you have removed the first line of quality control."

Garments with sewing defects must be reworked, sold at a discount, or discarded, creating significant financial losses for companies. Dr. Lewis Dorrity, associate professor of textile engineering, has been working on advanced sensor technology to substitute for -- and even improve on -- quality control responsibilities now handled by humans.

While joining pieces of fabric together, sewing needles normally push aside the threads that make up a piece of fabric. Dull needles, however, can break the individual threads, causing visible defects in the garment and weakening the fabric at the seam.

To reduce the problem, apparel companies now replace the needles periodically. But because needles can wear out at different rates, some of them become dull before they are scheduled to be replaced. If technicians could determine when the needles actually become too worn for use, however, they could replace them individually as needed.

Using a piezoelectric transducer that picks up sound, along with sophisticated computer analysis, Researcher Bernard Gunn measured the acoustic energy given off by sewing needles that had been subjected to varying degrees of wear. Computer analysis and a technique called Fast Fourier Transform revealed certain sound frequencies whose amplitudes increased when worn needles were used. The amplitude increase was proportional to the amount of needle wear.

Gunn, who has since graduated from Georgia Tech, then used an electronic filter to screen out all but acoustic energy of the frequency produced by the needles. The resulting signal could then be fed into an alarm device that would turn on a light to summon operators for a needle replacement when the wear levels passed a pre-set maximum.

"The operator would only need to know that when the light comes on, it is time to change the needle," he said.

Worn needles, however, are not the only problems causing product defects for apparel manufacturers. Gunn and Research Scientist Dr. Mathew Sikorski used both optical and scanning electron microscopes to study needles provided to them by apparel companies. What they found was that many of the needles -- removed from company sewing machines for replacement -- were broken or chipped rather than simply worn.

Because chipped or broken needles may also cause sewing defects, researchers hope to develop sensing techniques to detect needle damage as soon as it happens. The research could also help the manufacturers produce needles less likely to chip or break.

Other apparel sewing problems can occur when a waxy lubricant used on thread builds up and clogs the eye of the needle, Sikorski learned. Thread tension is also important, and a poor adjustment can cause defective stitching. And if the sewing needle misses a ply in a complex seam, the garment will be seriously weakened.

Sikorski believes sensing techniques similar to those developed for needle wear will ultimately be developed to monitor these parameters, opening the way for automated sewing operations.

"Within a few years, we have to be able to detect all of these sewing defects to have sewing machines operate totally automatically," he noted. "It's just a matter of using the right approach. If something goes wrong, the machine will stop."

Despite the importance of what they will do for the automated factories of the future, parts to build the sensing devices can be purchased for about $50 per machine, Olson estimated. By reducing the number of defective items, he suggested, they should quickly pay for themselves.

What will all these changes in the century-old sewing process mean to manufacturers and consumers?

"With the help of this technology, each unit will cost less because there will be fewer errors and the quality will be close to 100 percent," Sikorski noted. "Now we can go to the bargain basement to buy inexpensive items that are seconds. In the future, we will buy inexpensive items that are not defective."

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