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Lower Costs Driving Vision's 'New Wave'

New products — less expensive and easier to use — are leading market growth

By Donald Christian

Machine vision technology is in a new wave of growth and usage. The wave's strength is a new generation of products recently introduced by automation equipment manufacturers to meet users' needs. This article examines reasons for the wave's success and some of the remaining impediments.

The new generation machine vision products are dramatically less expensive: installations which previously cost \$50,000 to \$75,000 are available now for \$5,000 to \$20,000. They are also much easier to use. Since their functions or "tools" are chosen from lists of pre-programmed selections, the products do not require computer programming skill. Animated computer graphics are superimposed on video images to pantomime interpretations of a scene and show how the analyses are made. The setup and configuration process is not unlike a video game.

Although the successful first generation products were broader in capability, they required considerable expertise and were narrowly applied. Application skills were concentrated in an elite group of technologists. New generation vision products have more limited image analysis functions but are useful in more diverse industrial applications.

Since the new products are preferentially compatible with existing control networks, they are tightly integrated with popular automation and control systems. Larger automation systems are readily assembled from these modular building blocks.

New generation products are for the most part machine vision sensors which have few or no other functions. A clear distinction has been noted between the vision *system* and the vision *sensor*.¹ The machine vision *system* has been

compared to a Swiss Army knife. It provides a number of functional blades, and has a blade for every occasion. However, most tasks require only one blade, and the others go unused. The machine vision *sensor* is like a piece from a child's tinkertoy set. An array of specialized and compatible parts is integrated by the user to build larger industrial systems. Most systems require several pieces, but no unnecessary pieces need to be purchased or integrated. This minimizes the cost and the complexity of the installed system.

The embedded microprocessors of a machine vision sensor cannot be programmed for general industrial control or computation. However, the sensor interfaces easily to the controllers and computers better suited to those purposes. This specialization of function follows directly from the tinkertoy strategy.

The new products have chosen plant engineers as their target audience. "Machine vision will be driven forward by shop floor engineers who can accept vision for what it is, namely, just another tool to be used where appropriate to improve quality and productivity."² The first of a series of machine vision performance standards will soon complete the formal certification procedure.³ These standards are being written by a group of users, vendors and scholars coordinated by the Automated Vision Association (AVA), a trade group. These standards will give users a basis for comparative performance testing and will help validate the performance claims of vision vendors.

Vision technologists now have a host of training options to choose from. The cost of machine vision training equipment (products) has decreased. Ven-

dors' product training schools are increasing in popularity as are the tutorials, clinics and videotapes published by the Society of Manufacturing Engineers' Machine Vision Association and by colleges and universities. Articles and papers about machine vision have increased both in quantity and quality over the past three years.

In some applications, machine vision has achieved spectacular success. In automatic integrated circuit bonding, for example, machine vision has played a key role in the growth of the semiconductor industry. This remains a powerful commercial incentive for other industries, and is a sufficient justification for the technology.

There are also intangible factors that are helping the growth of the machine vision industry. For example, machine vision applications engineering is still more an art than a science. This makes it a gratifying occupation for creative people. And machine vision is a glamor industry; it still has a science-fiction-like aura of mystery and genius.

Earlier predictions of machine vision growth were enthusiastically optimistic, but over the past four years actual growth has been somewhat unimpressive. Although the new generation of products is making significant advances, some of the technical, commercial and social barriers still exist.

Most potential users still don't have a clear understanding of the strengths or the limitations of machine vision technology. The nature of the parameters that are sensed and measured has not been clear.

Some companies with successful machine vision applications and technologies maintain trade secrecy so as to retain a competitive advantage. This makes it difficult for prospective users to be aware of or to understand successful machine vision applications.

New users often have unrealistically optimistic expectations. If these expectations are not fulfilled, the backlash can be harsh.⁴ Some users are misled by the term "vision" to expect that machine vision approaches the awesome sophistication of the human eye. Other users have been swayed by overstated

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performance claims from naive or overenthusiastic vendors, a phenomenon not uncommon in the introductory phase of new technologies.

The broad spectrum of potential machine vision applications makes it difficult for users to understand what machine vision does well. For devices that do "whatever you program them to do," it is hard to explain precisely what they can do.

There is a natural human resistance to new technologies. Until a technology is proven fully satisfactory on user terms, the natural reluctance to risk prevails. This factor is especially important when the science fiction specter of a human replacement appears. Although labor-conserving devices prevail in all developed countries, fear of their impact on employment still exists in some circles.

Differing terminologies for similar functions confuse the process of machine vision equipment selection. The terminology standards being developed by the Automated Vision Association and the Institute of Electrical and Electronics Engineers (IEEE) will help this situation.

Relatively few people have machine vision applications engineering skill. It is an interdisciplinary practice involving optics, illumination, systems integration, real-time control, intercomputer communications, troubleshooting and maintenance, and specific knowledge about the target manufacturing process. More people are acquiring these critical skills as the new generation of products continues to proliferate.

The machine vision industry has entered a major growth phase because of a new generation of vision products. The products are being used in new applications and in many manufacturing industries. The new growth is attributable to the improved usability of the new products, clearer knowledge of the appropriate applications and improvements in the associated educational systems.

"Vision Sensors or Vision Systems?," Bill Vogley, *Sensor Review* magazine 7(3), July 1987, p.152...160.

"A Hitchhiker's Guide to Vision Systems," C. Loughlin, *Sensor Review* magazine 8(2), p.93...99, April 1988, IFS Publications 0260-2288.

"Performance Standard for Measurement of the Position of a Point in Space," draft document A15.05 N33 (currently in public review circulation), Automated Vision Association, Romulus, Mich., May 1988.

"Getting the Vision: Largest reason for failure has been unrealistic high expectations," *Manufacturing Week* 22, Feb. 1988, p.19.



Angstrom's SCANLINE system.

Angstrom Uses Cognex

Needham, Mass.—Cognex Corp. has signed a contract to supply Cognex 2000 pattern recognition systems to Angstrom Measurements in Sunnyvale, Calif.

Angstrom recently introduced the SCANLINE Electron Beam Comparator, a scanning electron microscope used for measuring sub-micron circuits during automated semiconductor wafer inspections. The Cognex vision subsystem built into each SCANLINE automatically performs image processing, identification and analysis during wafer inspection. The vision system locates desired images and critical dimensions within its viewing field by comparing each to a learned image model, centering the image, and repeating the procedure until the microscope reaches the desired magnification level.

'Light Bridge' Guides Vehicles

Bellevue, Washington — Philipp Technologies Corp. has combined a new "light bridge" signal acquisition principle with microprocessor technology to function as a simplified machine vision system.

The enhanced optical sensor and controller can scan a broad field of view at extended distances compared with conventional sensing techniques. The sensor, configured in ranging mode with pulse width modulated output, has been used with a panning mechanism for guidance and collision avoidance of automated moving vehicles. The light bridge sensor is being used for applica-

Boeing, TI Buy Systems

Redmond, Wash. — Technical Arts Corp., a company specializing in non-contact 2D (graphic) and 3D (solid) measurement systems, has received follow-on contracts from The Boeing Co., Honeywell Inc., and Texas Instruments.

The Boeing Co. has contracted with Technical Arts to design and build a precision formed tubing inspection system for quality and process control in the tube shop of Boeing's Everett, Wash., facility. Earlier developmental work for Boeing amounted to \$200,000. The most recent production contract is for an additional \$550,000. The contract represents a breakthrough which eliminates steps such as tooling, setup and part programming, according to the company.

Late in 1987, Technical Arts was awarded a \$240,000 contract by Honeywell Inc. for a second inspection system identical to one purchased earlier to collect precision dimensional data from metal disks used to make explosively formed projectiles.

From Texas Instruments' lead frame stamping operations in Attleboro, Mass., Technical Arts has received a contract for two software upgrades to a Lead Frame Scanner that had been delivered in January 1986. The scanner does a final part inspection before the product is packed for shipment to the customer. This \$96,000 contract is expected to result in a multi-unit follow-on order.

tions which, in the past, were unable to use photoelectric sensing techniques.

The light bridge mechanism enables sophisticated microprocessor-based signal processing as part of the detection process to provide sensitive and reliable pulsed active infrared (PAIR) sensors. The sensor exhibits improved detection limits over conventional PAIR sensors, with the dynamic signal range typically improved to at least 63 db.

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