During 1985 and 1986, many major semiconductor companies have introduced VLSI graphics components. This issue focuses on the new technology. These chips will enable interactive computing to reach an important new level of price/performance. Most of these new components bring the performance levels of today's $20K-$40K workstations to desktop computers in the $5K-$10K range, or even lower. An important recent study by J. Brady, "A Theory of Productivity in the Creative Process," IEEE CG&A, May 1986, shows that improved responsiveness of the user/computer can improve productivity by factors of two and more—dramatic by any measure.

We knew the topic for this special issue was a good one, and we didn't anticipate any difficulty in obtaining good articles. Because of the complexity of these VLSI designs, most of the important work is going on in industry. But it seems that people in industry are very busy. Still, after only a two-month delay in our original schedule, we have been able to assemble the issue and are pleased with the articles.

We had hoped to obtain articles from an international base, especially Europe and Japan. However, we were not successful in obtaining articles from outside the US.

The VLSI components described in this issue all provide high levels of functional integration when compared with their predecessor implementations. As a rule, they reduce the number of IC packages in the graphics subsystem while providing silicon support of pixel-intensive operations. Three of these pixel-intensive functions are video generation, the setting of bits in a bitmap, and the moving around of bits in a bitmap. These and other functions are accomplished at very high speeds.

Traditional graphics systems have been built with "bit-plane" architectures. Graphics components from Advanced Micro Devices, National Semiconductor, and NCR reflect VLSI adaptations of this basic approach. These bit-plane architectures offer the highest performance potential for systems with over 4 bits per pixel.

Graphics components from Hitachi, Intel, and Texas Instruments, however, represent architectures with "packed pixels," where the individual picture elements (pels or pixels) are packed into computer words in a linear-addressing structure.
For example, one 16-bit word will hold 16 1-bit pixels or two 8-bit pixels, much like the storage of ASCII characters as 8-bit bytes. This new packed-pixel approach provides a clean "view" into the graphics bitmap for the software when computation involving individual pixels is needed. This approach also leads to a smaller number of pins in the graphics system for implementations that have over 4 bits per pixel. Lower pin count leads to lower ultimate system cost and higher system reliability—important for sustaining the VLSI cost trends we have all come to expect. The packed-pixel architecture trades lower system cost for lower—but perhaps adequate—performance.

This special issue doesn't cover one very important related topic: graphics software standards. (See the August 1986 issue of *IEEE CG&A*.) The struggle for standardized software is due in part to the poor performance of low-cost graphics systems. In fact, there is normally no VLSI hardware at all to accelerate graphics software in the world's 15 to 20 million desktop computers. As a result, the application software suppliers have been unwilling to compromise interactive performance for a standardized approach, so they wrote directly to the hardware. Now, with the advent of new VLSI graphics components such as those described in this issue, the application software can be written to take advantage of rapid changes in VLSI technology and to be developed in a hardware-independent manner. De facto and formal graphics standards should be in common use within the next two years.

This special issue on VLSI graphics components contains three articles representing recent technological innovations:

Mike Asal et al. from Texas Instruments describe the TMS34010. This component is a new 32-bit RISC processor with special silicon added to accelerate graphics functions. It features an innovative set of arithmetic operations on pixels, providing new, high-speed computation capabilities for colored-pixel values.

An article by Charles Carinalli and John Blair describes a new chip set from National Semiconductor. This set is intended to provide even higher levels of performance for today's workstations. By dedicating components to bit planes, designers have enabled the pixel-intensive operations to maintain their performance as higher bit-per-pixel systems are designed. This set of components shows how to gain the cost/performance advantages of VLSI without departing from the traditional bit-plane architecture.

Glen Shires' article discusses the Intel 82786 graphics coprocessor. This component features very high speed graphics primitives and an interesting innovation: hardware support for windows. This window support is characteristic of what can be done with a small silicon area. The implementation cost of this capability in TTL or in external gate arrays would be prohibitive, yet the incremental silicon area is very small.

We hope you will read all the articles to fully appreciate the quite different approaches they represent. Taken together, they dramatically reveal the power that VLSI can bring to interactive computing.

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