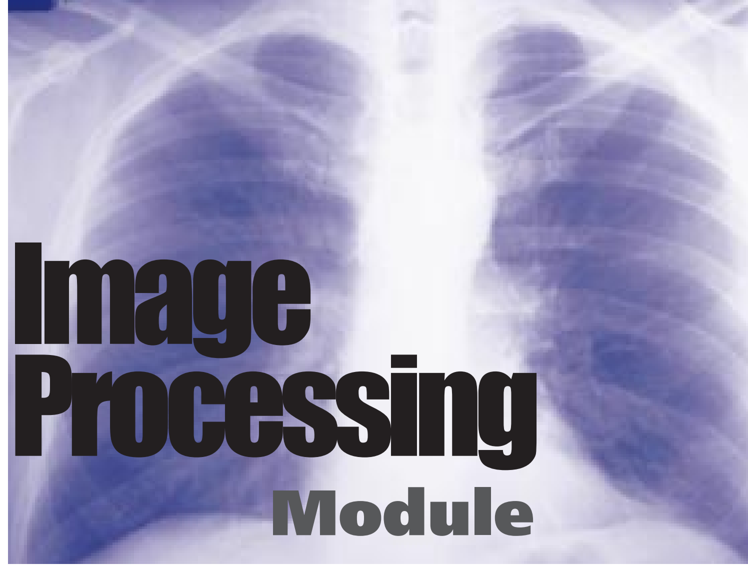

VisiCom Uses Xilinx FPGAs for a Reconfigurable Image Processing Module

The combination of the Virtex hardware, associated software tools, and engineering process improvements have proven to be a great success.

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When VisiCom needed a high capacity, high performance FPGA for a real-time video processing board, they chose the Virtex series FPGAs from Xilinx. Since 1997, VisiCom has specialized in using FPGAs to rapidly deploy customer-specific real-time image and video processing systems for a variety of applications, including semiconductor process equipment, medical imaging, scientific imaging, factory floor automation and defense/aerospace electronics.

About VisiCom

VisiCom's FPGA-based approach combines the real-time performance of hardware-accelerated algorithms with the ability to modify or upgrade the algorithm without physically changing the hardware. This provides a means to reconfigure hardware and software quickly and efficiently to suit specific customer requirements, resulting in reduced time to market, significant cost savings, and better lifecycle support. In addition, the use of FPGA technology avoids the non-recurring engineering costs usually associated with fabricating ASICs, while still providing most, if not all, of the performance features.

"With the FPGAs used in our earlier projects, we found we were spending a great deal of time 'hand-crafting' algorithms to make them fit in the part and achieve timing closure," stated Ron Hawkins, chief operating officer of VisiCom's Computer Products Division. "A lot of effort from our most experienced engineers was required, tying up valuable engineering resources and delaying customer deliveries. We realized this was unacceptable to us and our customers, and something had to change." VisiCom's engineers needed a solution that would allow them to spend more time on design and simulation and less on post route and hardware debug.

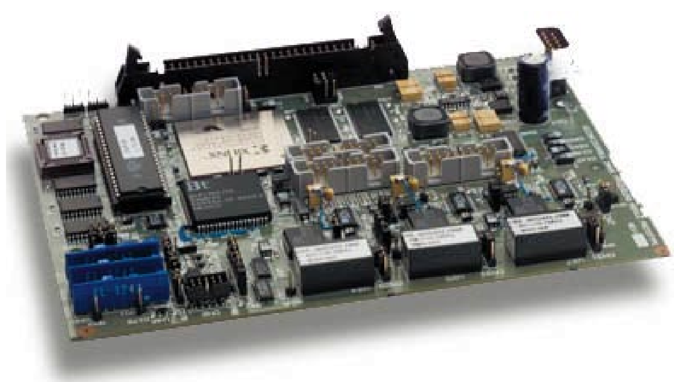

Figure 1 - Visicom board.

The opportunity to change occurred when VisiCom was selected to design a custom embedded, reconfigurable image processing module for a medical imaging system. The system in question had demanding requirements; it called for processing full bandwidth video ("4:4:4" luminance and chrominance bands) in real-time using several image processing and ancillary operations. The processing requirements included color space conversion, enhancement (convolution), and affine transformation (rotation, scaling, and translation). These operations represented a significantly higher degree of integration on silicon than had been previously attempted by VisiCom engineers. In addition, the new module was replacing an existing module that had become obsolete. The new module needed to accommodate specific size and power constraints.

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Using the Virtex Series

VisiCom's engineers chose the largest capacity FPGA available from Xilinx, the million-gate Virtex series, as their solution. Virtex provides more gates and routing resources, making it easier to achieve timing closure with the synthesis tools available. "We bet on two things," continued Hawkins.

"First, we bet that Moore's Law would apply to FPGAs, that equivalent gate counts would continue to increase rapidly, with the cost per gate declining over time. Therefore, we concluded that even if the target part did not meet our cost requirements, it would by the time we fielded the product. This meant we could select a part that had plenty of resources to meet our needs and still have confidence that our cost targets in production could be met."

"Second, we bet that the EDA tool vendors would continue to improve their products to achieve optimum utilization and routing within FPGAs. We decided that the problem of optimally synthesizing, placing and routing logic was a problem for the tool vendors to solve, not us. This assumption meant we could devote a greater percentage of effort to analyzing our application problem and designing a solution, and spend less time getting it to work in the part. We relied on the EDA tools to handle this, permitting better use of our engineering resources to focus on solving the application problem at hand."

These assumptions proved correct. VisiCom engineers converted from schematic design

capture to VHSIC Hardware Description Language (VHDL). The imaging algorithm designs had to be more abstract, modular, and reusable, to meet time-to-market constraints and support reuse in future designs. The software-like properties afforded by VHDL, such as encapsulation and parameterization, offered significant advantages relative to schematic capture. The support in VHDL for the creation of design libraries and reusable components was also essential to VisiCom's strategy for rapidly fielding future FPGA-based imaging systems to meet specific customer requirements.

The company's engineers also placed more emphasis on establishing a formal design methodology to guide the work effort from analysis and high level design of the imaging algorithm, through VHDL coding, and ultimately, synthesis into the Virtex part. The software tools available for the Xilinx Virtex series complemented this methodology and the use of VHDL. VisiCom integrated a high-level signal processing and analysis tool, MATLAB(tm) from MathWorks, into the design flow, creating a framework for analyzing and verifying the imaging algorithms before beginning VHDL coding.

Extensive use was made of VHDL test benches for thorough simulation and verification of the design after it was committed to VHDL. A procedure was established for processing video fields with both the MATLAB and VHDL simulations, and comparing the results to ensure proper implementation. The methodology also includes use of post-route simulation to ensure timing closure. As a result of using MATLAB, VHDL, and extensive simulation, relatively little time was spent debugging the physical hardware.

Another benefit of using the Virtex series was the high number of usable I/O pins. This feature permitted VisiCom engineers to lock the FPGA pinout early in the project, so the physical board design and fabrication could proceed concurrently with the VHDL coding of the imaging algorithms. The end result was the imaging board was ready and waiting upon completion of the fully simulated imaging algorithm. "The engineers downloaded the bitstream, made a few tweaks, and our imaging board was up and running," said Hawkins.

The combination of the Virtex hardware, associated software tools, and engineering process improvements have proven a great success in creating a solid product for use in the customer's medical imaging system. VisiCom not only achieved a faster time-to-market, but also completed a real-time imaging project of significantly greater scope than had been previously attempted. As a basis for comparison, VisiCom engineers estimated that seven commercial VLSI imaging chips and SRAM memory would have been required to achieve the same results at a greater cost than VisiCom's solution, which used a single Xilinx XCV-200 part with SDRAM memory.

In the customer's medical imaging system, a single Virtex part replaced multiple smaller capacity parts and provided a smaller footprint, lower power requirements, more capability, and lower overall cost. Based on their experiences with this project, VisiCom's design team is now working on their next real-time imaging design using the Virtex-E architecture.

For more information, visit the VisiCom website at: www.visicom.com. Or, e-mail: sales@visicom.com