Summary

EIZO GmbH, Display Technologies has chosen Xilinx FPGA as a basis for several graphics controller boards for cutting edge medical monitors. That choice was largely dependent on existing Xylon logicBRICKS IP cores and Xylon's level of expertise demonstrated during the project's evaluation stage. Though ultra-high requirements related to medical monitors suggest usage of high-end Xilinx® FPGA devices, Xylon together with the EIZO team has managed to implement all FPGA designs in cost sensitive Xilinx Spartan®-3 devices. The resulting FPGA graphics controller board makes a development basis for future EIZO GmbH, Display Technologies developments, and assures support for future changes that might occur in existing monitors. This customer success story shows how Xylon logicBRICKS IP cores and design services can serve the demanding medical imaging market that needs performing graphics solutions.

Challenges in Medical Imaging

Medical imaging is a growing segment of the medical market. X-ray, angiography, digital radiography, computer tomography, and such, are examples of medical applications requiring high-end medical monitors for valuable diagnostic data display. Targeted applications leave no space for excuses to manufacturers of the medical monitors. Monitor users expect ultimate picture quality, fast graphics data processing, ergonomics and an easy use, besides reliability at a level enabling vitally important decisions to be made.

The high-end medical monitors are complex digital systems composed of several components that must be carefully selected and designed. Aside from the LCD display, the graphics controller board is probably the component that sets the largest number of design dilemmas.

Heart of every graphics controller board is a single or more graphics controller chip(s). The graphics controller chip must often support ultra high resolutions and various specifics of LCD displays that might be market news. Performances must be very high, flexibility through software configurability is a necessity, and the graphics chips must be market available when needed.

FPGAs Do the Trick

There is no ultimate silicon component that covers all versatile requirements of whole manufacturers' line ups, and usage of different chips generates additional problems for design teams: different PCB designs, IOs connectivity, SW drivers, maintenance issues, long term availability, memory types, possible obsolescence, etc.

A quick insight look into requirements list exposes a design arena in which the FPGA technology fits perfectly. Today's FPGA chips allow high-performance DSP processing by parallelization of hardware executed algorithms, offer unprecedented configurability and allow for an easy adoption of new and emerging IO standards.

Fast development time, time-to-market and relatively low NRE costs, combined with typical midsize production volumes in the medical imaging, make FPGAs very competitive in design of graphics controller boards. Though this market can absorb bit higher silicon costs, there is no need for it. The FPGAs provide cost/performance ratios that compete evenly against ASSP/ASIC graphics controller chips.

Leading Company's Experience

EIZO GmbH, Display Technologies, a subsidiary of Eizo Nanao Corporation, is a leading manufacturer of monitors for medical imaging applications, and the company that certainly knows how to cope with the market's demands.

The company's lineup includes grayscale and color monitors from 1 to 10 megapixels, calibration tools and graphics boards.

Photo courtesy of EIZO GmbH

Advantages of the FPGA technology have been well-known to EIZO GmbH, Display technology design team who has used FPGAs in older designs. The team was looking for right solutions during a specification phase of a new controller board for grayscale and color monitors with resolutions spanning from 3 to 10 megapixels. One of the major team's goals was development of a modular graphics controller board supporting different assembly options and supporting a number of different monitors, which had to be capable enough to support future challenges.

Summary of design requirements has included: undisputable performances, DVI inputs compliance and the DVI input timing analyzer for input picture's format recognition, real-time picture rotation and input/output synchronization with no loss of frames, data correction, sophisticated backlight control with an addition of backlight sensors control, SDRAM controller assuring memory bandwidth measured in GB/s, internal color look-up tables (CLUT) and dithering, changeable color depths and formats, monitor system control, microcontroller (µC), and modularity enabling re-use in different graphics chip's setups.

Team Up with Xylon

After an exhaustive evaluation period, the EIZO GmbH design team has decided to deploy an FPGA based graphics controller chip. They have chosen Xilinx, Inc., the global FPGA leader, for silicon supplier.

FPGA design of required complexity called for an expert design FPGA team experienced in designing graphics solutions, and a number of pre-design IP cores to shorten the development time. EIZO GmbH, Display Technologies has engaged Xylon, an electronic company focused to FPGA design developments and a reliable Xilinx Alliance Partner.

Resulting in a high level of mutual satisfaction, the design of the graphics controller board was finished in several months. Such a successful design process would not be possible without very good synergy between EIZO GmbH and Xylon teams.

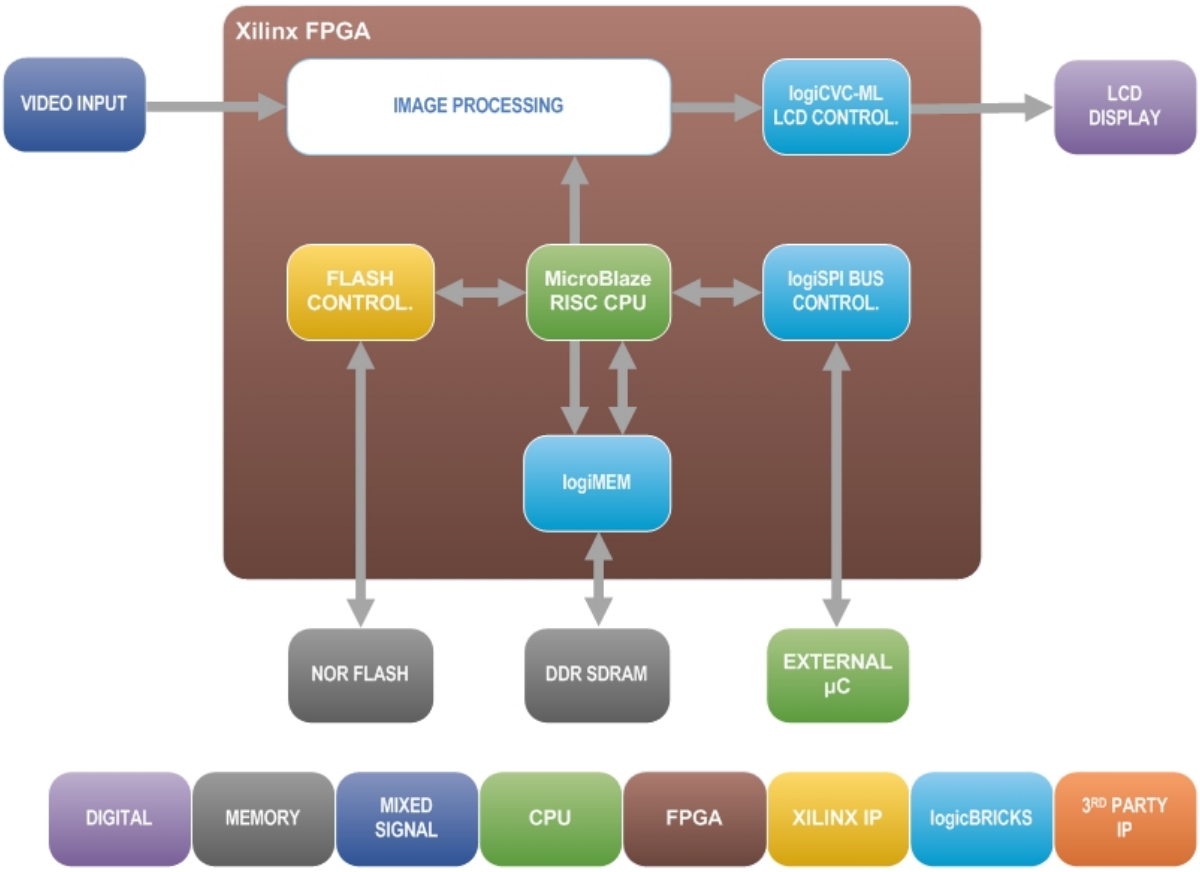
Throughout all stages of the design process of the graphics controller board, led by EIZO GmbH team, Xylon engineers have actively participated by proposals for better FPGA controller interfacing with the board.

Instead of delivering a final FPGA design from Xylon to EIZO GmbH, the whole design process has been divided into milestones. This approach has assured EIZO GmbH engineers an early access to intermediate FPGA design phases and a simultaneous testing on both sites. Iterative designing has allowed for an early bug removal and targeted system architecture changes resulting in proven FPGA designs fitting all initially set requirements.

Ultra-high Speed logicBRICKS Graphics Controller

Designing from the scratch has not been a viable approach in designing advanced FPGA designs for a while. Strong and capable design teams use predefined function blocks or IP cores, which are either in-house developed or purchased from third-party IP providers.

Xylon has a number of graphics functions IP cores in its IP core library called logicBRICKS. Existing IP cores have allowed our engineers to quickly assemble a starting FPGA design and concentrate to missing details and additional IP cores tuning.



The FPGA Block Diagram

The presented block diagram is an exemplifying FPGA block diagram. Real FPGA architectures used in the presented projects are sometimes divided among multiple FPGA chips to support extremely high resolutions of some monitors.

Video input module designed by Xylon accepts video input from an external DVI receiver. The module can automatically detect input frames' timings and accordingly setup other modules of the FPGA. The input video can be rotated and stored into an external DDR SDRAM memory pool offering very high data bandwidth. The memory pool is being controlled by fast Xylon's logiMEM multi-ported SDRAM memory controller. Besides the video data to be displayed on the LCD, the memory is also used for storage of display's correction parameters, and can be used for storage of the On-Screen-Data (OSD) data.

Color look-up tables are used for control of correct gray levels and can be reprogrammed by monitor control software. Users can easily adopt the monitor's picture by pre-programmed monitor setups that can be fast exchanged. Dithering expands pixels color depths and immensely improves quality of the displayed picture.

The logiCVC-ML LCD controller is Xylon's mature product that enables multilayered LCD control and sends the processed graphics data through multiple LVDS lines towards the LCD display. LCD panels expecting separated control of internal segments can be simultaneously controlled by multiple logiCVC-ML instances. Video inputs and video outputs must be perfectly synchronized to each other, and to display parameters correction unit as well.

System's operation is being controlled by the Xilinx MicroBlazeTM soft-CPU. The MicroBlaze communicates with an external microcontroller that actually controls an overall operation of the monitor.

Revision History

Version	Date	Note
1.00	10.03.2010.	Initial release.

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