Trends in Embedded Design Using Programmable Gate Arrays

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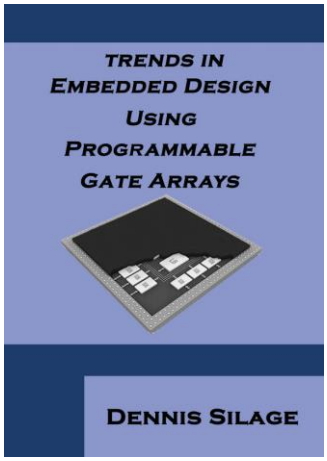

Trends in Embedded Design Using Programmable Gate Arrays describes the analysis and design of modern embedded processing systems using the field programmable gate array (FPGA). The FPGA has traditionally provided support for embedded design by implementing customized peripherals, controller and datapath constructs and finite state machines (FSM). Although microprocessor-based computer systems have usually been used for the design of larger scale embedded systems, the paradigm of the FPGA now challenges that notion of such a fixed architecture especially with the constraints of *real-time*.

This new paradigm in embedded design utilizes the Verilog hardware description language (HDL) behavioral synthesis of controller and datapath constructs and the FSM for digital signal processing , communications and control with the FPGA, external interface *hard core* peripherals, custom internal *soft core* peripherals and the *soft core processor*. The transition to embedded design with the parallel processing capabilities and coarse grained architecture of the modern FPGA is described by in-part by the translation of C/C++ program segments for real-time processing to a controller and datapath construct or an FSM. However, the availability of the Xilinx 8-bit PicoBlaze™ and 32-bit MicroBlaze™ soft core processors and the emergence of the ARM® hard core processor and AMBA bus for the Xilinx Zynq™ Extensible Processing Platform (EPP) now also challenges the conventional microprocessor with its fixed architecture for embedded design.

Trends in Embedded Design Using Programmable Gate Arrays features the Xilinx Spartan®-6 FPGA on the Digilent Nexys™ 3 Board and the Atlys™ Board evaluation hardware, the Xilinx Integrated Synthesis Environment (ISE®) electronic design automation software tool in the Verilog HDL, Xilinx CORE Generator for LogiCORE™ blocks and an introduction to the Xilinx Zynq EPP. The complete Xilinx ISE projects and Verilog HDL modules described in the Chapters are available as Archived Project Files.

Trends in Embedded Design Using Programmable Gate Array is intended as a supplementary text and laboratory manual for undergraduate students in a contemporary course in digital logic and embedded systems. Professionals who have not had an exposure to the coarse grained FPGA, the Verilog HDL, an EDA software tool or the new paradigm of the controller and datapath and the FSM will find that this text facilitates an expansive experience with the tenets of digital signal processing, communications and control in embedded design. The References sections at the end of each Chapter contain a list of suitable undergraduate and graduate texts and reference books.

KEY FEATURES

- A complete description of the Xilinx ISE WebPACK™ v14.4 electronic design automation environment suitable for undergraduate and graduate students and professionals
- Intended as a supplementary text and laboratory manual for undergraduate students in a contemporary course in digital logic and embedded systems
- Professionals can benefit from the *hands-on* experience of real-time embedded projects in DSP, digital communications and digital control for the Digilent Spartan-6 Nexys™ 3 Board and Atlys™ Board
- Introduces the controller and datapath construct and the FSM in the Verilog HDL for high-speed embedded design using Xilinx LogiCORE blocks
- Provides Archived Project Files for the complete Xilinx ISE WebPACK™ projects described in the text with new projects available for download with further development

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Chapter 1: **Verilog Hardware Description Language:** Verilog syntax and concepts, structural and behavioral models in the Verilog HDL, FSM, controller and datapath construct, C to Verilog translation, FPGA and microprocessor comparison

Chapter 2: **Verilog Design Automation:** Xilinx ISE WebPACK, Xilinx CORE Generator, Xilinx Plan Ahead, Xilinx Floorplanner, Xilinx Simulator, Xilinx Architecture Wizard, Xilinx LogiCORE blocks, warnings and errors in synthesis

Chapter 3: **Programmable Gate Array Hardware**: Digilent Spartan-6 Nexys™ 3 Board and Atlys™ Board evaluation board hardware components and Digilent Pmod™ peripherals and sensors, AC-97 codec

Chapter 4: **Digital Signal Processing, Communications and Control:** sampling and quantization, discrete time sequences, discrete frequency response, DSP embedded system, FIR digital filter, FIR Compiler LogiCORE block, Direct Digital Synthesis Compiler LogiCORE Block, digital data communication and control

Chapter 5: **Extensive Processing Platform:** Xilinx Zynq-7000 EPP and Zedboard

AUTHOR BIOGRAPHY

Dennis Silage (Philadelphia, PA) is a Professor in the Department of Electrical and Computer Engineering at Temple University. He has a Ph.D. in Electrical Engineering from the University of Pennsylvania. He is a senior member of the IEEE and director of the System Chip Design Center *www.temple.edu/scdc*, which researches the application of Xilinx field programmable gate arrays in digital signal processing and digital communication.