"Dual Port RAM Implementation on FPGA with Verilog and System Verilog - Driven Test benches"

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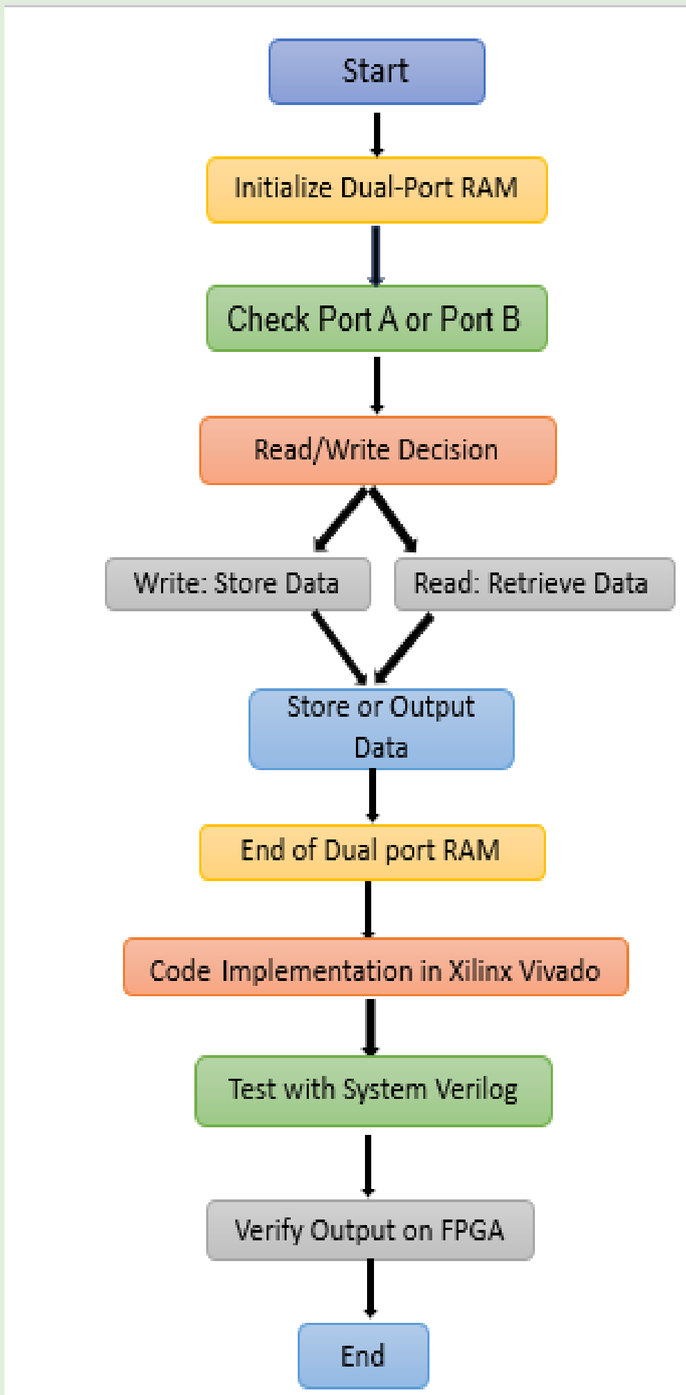
Abstract

➢ **Design & Implementation**: Developed Dual Port RAM (DPRAM) on FPGA.
➢ **Parallel Operations:** Supports simultaneous read and write on two Independent ports.
➢ **Hardware Description**: Implemented Using Verilog for FPGA synthesis
➢ **Verification**: Used System Verilog-drive testbenches for robust functional testing.
➢ **Simulation & Synthesis**: Conducted Using Xilinx Vivado for FPGA deployment
➢ **Timing Analysis**: Conducted static timing analysis to guarantee correct operation at the desired clock frequency.
➢ **Resource Optimization**: Maximized the memory and logic resources to deliver effective usage of hardware.

Background

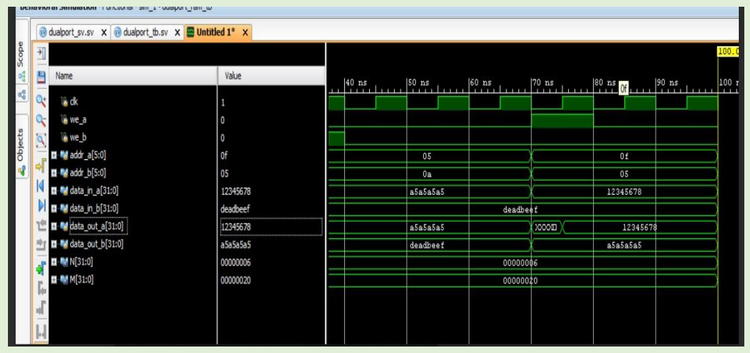
➢ **Understand Dual-Port RAM:**
Explore how Dual-Port RAM (DPRAM) enables simultaneous read and write operations on two independent ports, enhancing memory efficiency compared to single-port RAM.
➢ **Verilog & SystemVerilog:**
Design and implement Dual-Port RAM using Verilog, focusing on memory arrays and concurrent access mechanisms, while utilizing SystemVerilog for advanced verification and functional testing.
➢ **Design and Test:**
Develop the RAM module in Verilog and verify its functionality using SystemVerilog-driven testbenches, ensuring correctness through rigorous simulation and debugging.
➢ **Implement on FPGA:**
Synthesize the RAM design for FPGA, deploy it on hardware, and perform real-time testing using Xilinx Vivado to validate performance, reliability, and efficiency.

Method

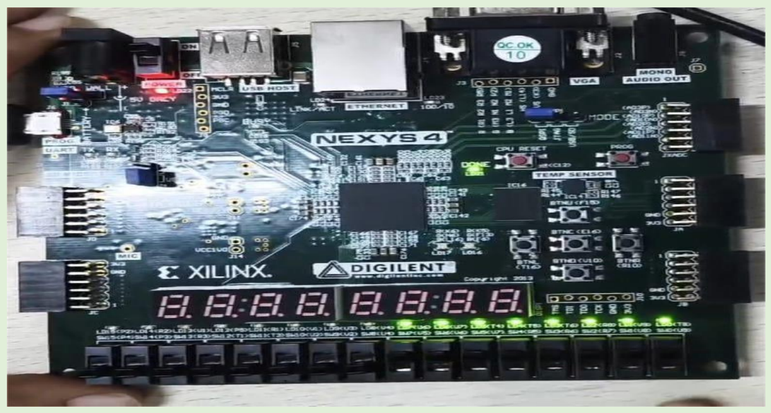


Results

SystemVerilog Simulation Result:



FPGA Implementation



Conclusion

✓ The design successfully optimized memory access, enabling fast parallel read/write and improving real-time performance.
✓ The module is reliable, scalable, and energy-efficient, ideal for FPGA-based embedded systems.

Future Perspectives

Image & Video Processing – Enables real-time encoding, decoding, and buffering for surveillance and multimedia.
Automotive Systems – Supports real-time sensor data processing in ADAS for safer driving.
Medical Imaging – Enhances MRI, CT scans, and ultrasound with fast data storage and retrieval.

Impact on Society

This project makes digital devices work faster and better. It improves medical scans for accurate diagnosis. It helps cars use smart systems to prevent accidents. It also makes the internet faster and more reliable. Plus, it saves energy and is eco-friendly.

To know more
GitHub link: https://github.com/Spriya-12/Project-EECE
Video link: https://drive.google.com/file/d/1XyabhVWfuPUyN_qM31UEqUJaojX8ESa-/view?usp=drivesdk