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August 28, 2023

1 Introduction

The aim of this report is to detail the implementation of various digital logic circuits using Verilog HDL (Hardware Description Language). The circuits encompass fundamental operations such as addition, subtraction, logical shifts, logical operations (AND, OR), and more. The report will provide an overview of the approach taken for each circuit's implementation, the methodologies used, and a brief summary of the achieved results.

2 Approach

For each logic circuit, we employed a modular design approach using Verilog modules. The circuits were constructed by combining basic gates and components such as AND, OR, NOT gates, as well as more complex modules like carry-look-ahead adders. The implementation process followed a consistent pattern: the definition of individual modules for each gate or circuit, wiring these modules together, and utilizing testbenches for verification.

3 Circuit Approaches

3.1 Addition (ADD8) Circuit

The ADD8 circuit was implemented using the carry-look-ahead adder design. It consists of two carry-look-ahead adder modules that work in tandem to perform 8-bit addition. The inputs were split into two groups of 4 bits each, and carry-out from the first module was carried into the second module. This approach ensures efficient handling of carry propagation and minimizes delays.

3.2 Subtraction (SUBTRACT8) Circuit

The SUBTRACT8 circuit was implemented by utilizing the addition circuit in conjunction with a NOT gate. The two's complement of the second input was obtained by applying the NOT operation on each bit and adding 1. The result

was computed by adding the modified second input to the first input using the ADD8 circuit.

3.3 Logical Shift Right (SHIFT_RIGHT) Circuit

The SHIFT_RIGHT circuit was implemented using a simple concatenation operation with a 0 appended at the leftmost side of the input, effectively shifting the bits to the right. This approach allows for efficient logical right shifts of the input.

3.4 Logical Shift Left (SHIFT_LEFT) Circuit

The SHIFT_LEFT circuit was implemented in a similar manner as the SHIFT_RIGHT circuit, but with a 0 appended at the rightmost side of the input. This operation achieves logical left shifting of the input.

3.5 Logical AND (AND8) Circuit

The AND8 circuit was implemented using the straightforward AND operation applied to each pair of corresponding bits from the two inputs. This approach results in a bitwise AND operation between the inputs.

3.6 Logical OR (OR8) Circuit

The OR8 circuit was implemented using the simple OR operation applied to each pair of corresponding bits from the two inputs. This approach results in a bitwise OR operation between the inputs.

3.7 Logical NOT (NOT8) Circuit

The NOT8 circuit was implemented by applying the NOT operation to each bit of the input. This approach results in inverting each bit of the input.

4 Conclusion

The implementation of various digital logic circuits using Verilog HDL has been successfully achieved. Through a modular approach, the circuits were designed and constructed by utilizing basic gates, components, and more complex modules. The circuits were then tested using appropriate testbenches to ensure their correctness and functionality. This project has provided valuable hands-on experience in digital logic design and Verilog programming.

In conclusion, the report demonstrates the importance of modular design principles in creating complex digital systems. Each circuit, regardless of its complexity, can be built from smaller, well-defined modules. This methodology not only simplifies the design process but also enhances reusability and maintainability.