INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 1)
Available online at www.ijariit.com

VHDL Implementation of 32-Bit Microprocessor

Kusumam Joseph
kusumamjoseph19@gmail.com
Musaliar College of Engineering and Technology, Pathanamthitta, Kerala

Merlyn Mariyam Varghese
varghesemerlyn@gmail.com
Musaliar College of Engineering and Technology, Pathanamthitta, Kerala

ABSTRACT

The digital design is a very broad field. Its applications can be found in our daily life such as in laptops, calculators, cameras etc. The VHDL has become an essential tool for designers in the world of digital design [1]. This paper presents the VHDL implementation of a 32-bit microprocessor. The structural VHDL model of the microprocessor is designed to perform 16 operations which include both logical and arithmetic operation. Here the microprocessor is divided into various sub modules and each of them was programmed using VHDL. The VHDL implementation and functionality test of the 32-bit microprocessor are done by using the Xilinx tool.

Keywords: ***32-bit Microprocessor, VHDL, Structural Modeling.***

1. INTRODUCTION

The microprocessor is an electronic device which consists of arithmetic-logic unit and control circuit. It is an integrated circuit that interprets and executes the programs and behaves intelligently. It operates at a speed of the internal clock. With each clock pulse, the processor performs the functions corresponding to the given instruction. Therefore the power of the processor can be calculated as the number of instructions per second.32-bit the microprocessor contains a number of basic modules which together works as the processor. Here the processor consists of 32bit registers, an arithmetic, and logic unit, a program counter, a decoder unit. The processor uses 32-bit data bus to communicate through the different modules like registers, Arithmetic logic unit, and program counter. Due to the advancement of the integrated circuit technology, the power of the processor has increased tremendously. Microprocessors are used in the embedded sector depending on their general purpose and special purpose application. It is widely used in devices to make it intelligent. The processor consists of different sections which altogether performs various functions. Here each of these modules was implemented by using the behavioral modeling style to describe how the operation of the microprocessor is being processed. This is done by using the hardware description language-VHDL.

2. MODELING STYLE

The microprocessor is a programmable device which accepts digital data as input and processes it according to the instructions, provides results as output. It can be considered as a data processing unit or a computing unit. It has similar capability to that of the central processing unit of a computer. Here the microprocessor consists of different sub modules. All these sub modules in the microprocessor design are coded in VHDL. High level design methodology allows managing the design complexity in a better way and reduces the design cycle without continuing the trend to compromise evaluation of design implementation options and designing at a higher level of abstraction delivers the following benefits [1]:

- Manages complexity: Fewer lines of code improves productivity, reduces error.
- Increases design reuse: Implementation of independent designs.
- Improves verification: Starts earlier in the process runs significantly faster.

The main advantage of using VHDL is that, it allows the behaviour of the required system to be described and verified before synthesis tools translate the design into real hardware and also VHDL allows the description of a concurrent system, it is a dataflow language, unlike procedural computing languages such as BASIC, C and assembly code, which all run sequentially, one by one.[2]

3. BLOCK DIAGRAM AND SPECIFICATIONS OF 32-BIT MICROPROCESSOR

The block diagram of the 32-bit microprocessor is as shown in the figure. It has different sub modules, such as program counter, registers, ALU etc.

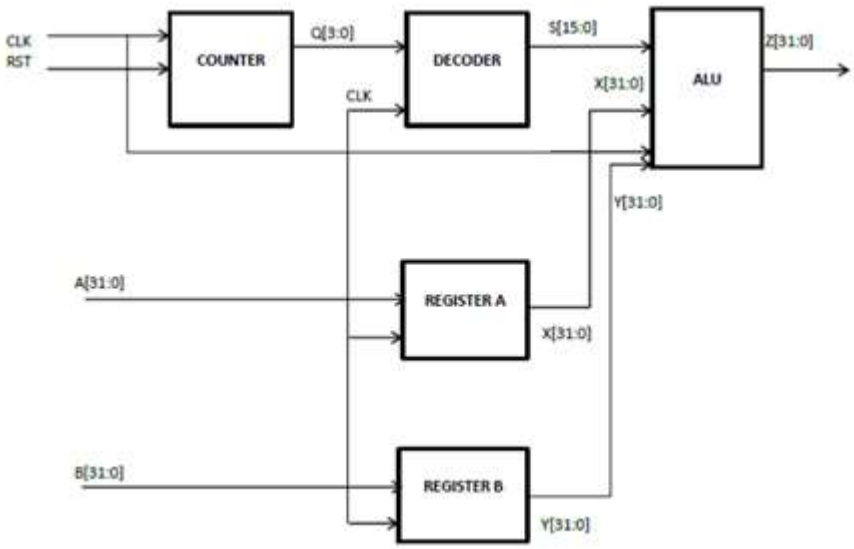

Fig: 1 Block Diagram of Microprocessor

3.1 Register Unit

Here we use two 32-bit registers. Register A and Register B. They are used for storing the value of instructions during processing. Registers are memory unit for temporary storage of data. The power and speed of the CPU generally depend on the availability of a number of registers and their size. Data can be written into the registers or can be read from the registers.

3.2 ALU (Arithmetic Logic unit)

ALU is the essential entity in processor since it contains arithmetic, logical and decision making operations such as AND, OR, NOR, NOT, NAND etc. It is considered to be the most important unit of the processor as the entire processor depends on it. [3] In ALU, two input data buses are used to provide data and the resultant output is obtained based on the desired operation.[4]

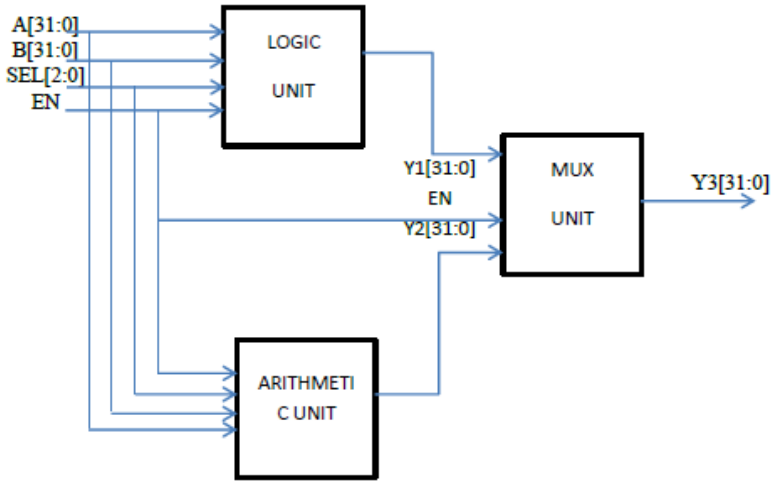

Fig: 2 Block Diagram of ALU

3.3 Counter Unit

The counter is used to record the number of events occurring in a specified interval of time. Usually, an electronic counter is used for counting the number of pulses occurring at the input line in a specified time period. The counter must possess memory so that it can remember its past states. The counter used here is a 4 bit counter. It starts counting from 0000 to 1111 when the clock signal is activated. The block diagrams as follows: The inputs to the counter are clk and reset when they are activated the counter starts working and it counts from 0000 to 1111.q is the output of the counter.

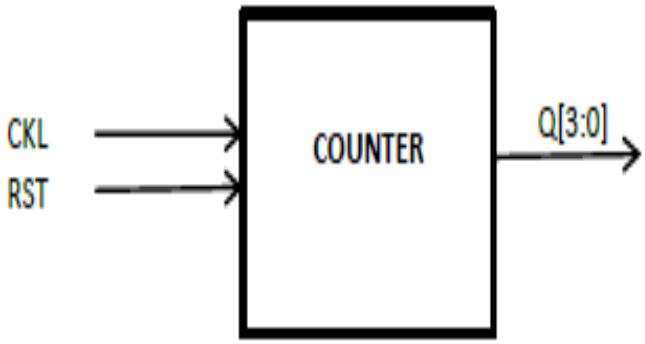

Fig: 3 Block Diagram of Counter

3.4 Decoder Unit

A decoder is a circuit that selects the binary information from the set of inputs. It selects a unique combination of inputs and generates output at the output line. The decoder can have control pins. Here the output of the counter is given as the input to the decoder, which is 4bit. Hence the decoder is a 4 to 16 bit decoder. The block diagram of the decoder is as follows:

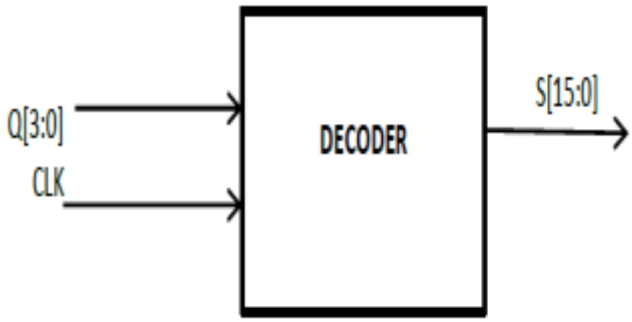

Fig: 4 Block Diagram of Decoder

4. SIMULATION RESULTS FOR 32-BIT MICROPROCESSOR

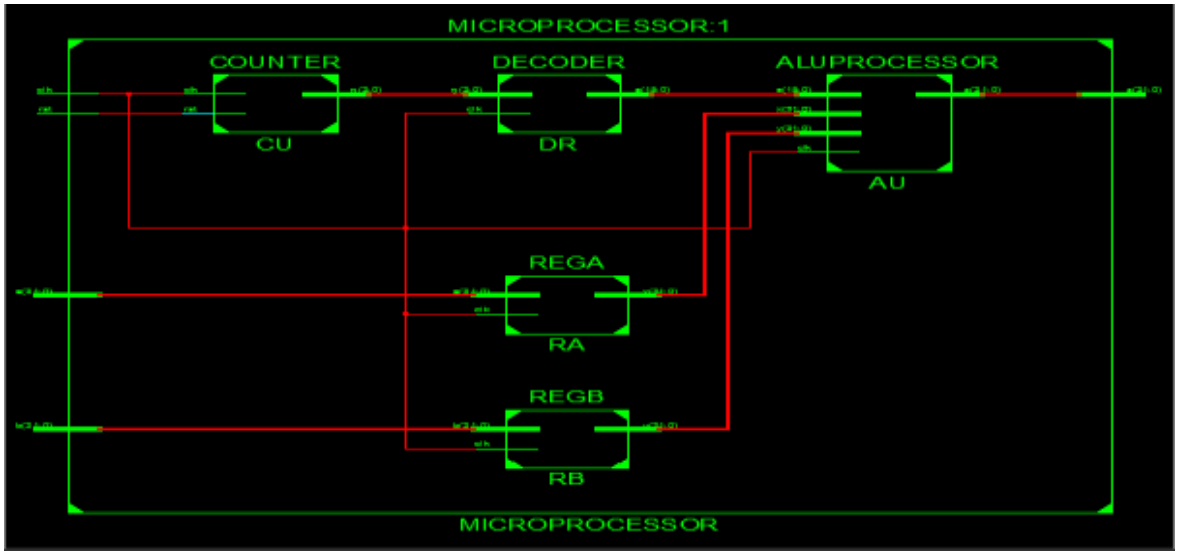

Fig 5. RTL Schematic of 32-bit microprocessor

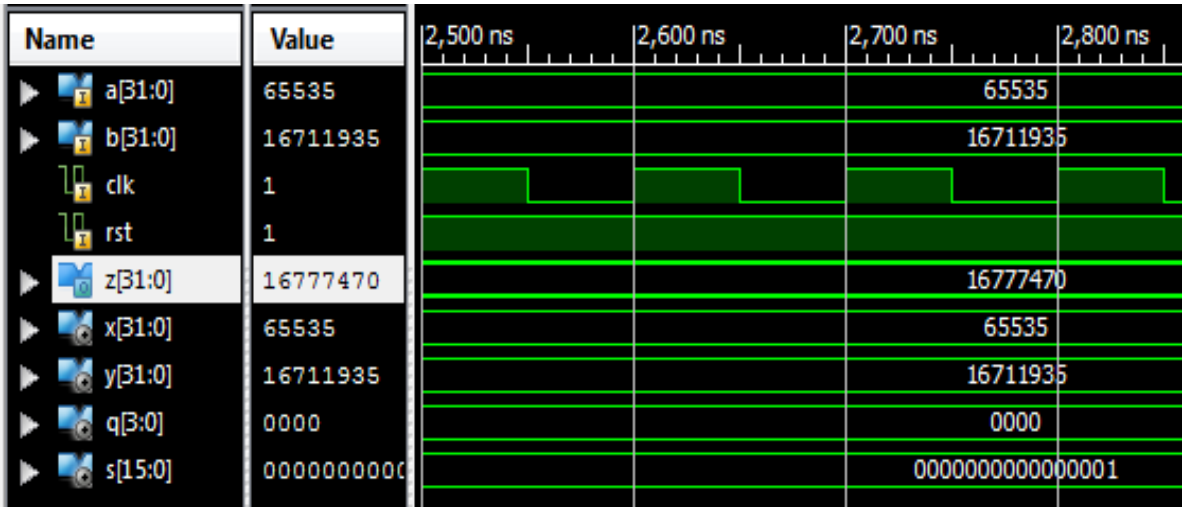

Fig 6. Simulation Result for Arithmetic Operation When S[0000000000000001] = X+Y

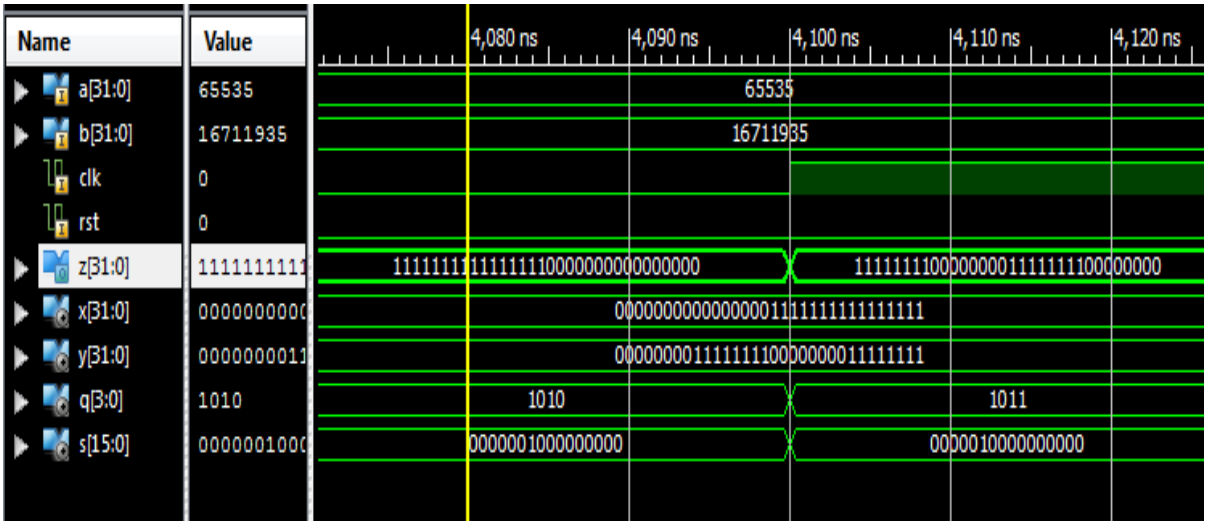

Fig 7. Simulation Result for logic operation when S[000000100000000] = NOTY

5. CONCLUSION

Microprocessors are a mass storage device. They can be also called as microcomputers. Due to low cost, low power, less weight and fast computing capability, it is widely used in different applications. In this paper 32-bit microprocessor using structural modelling is implemented. After writing VHDL code for each of the sub modules, the microprocessor was simulated. The complied format was loaded into the simulator, and the simulator was executed. This is done by Xilinx simulator. After the successful compilation and simulation, we can conclude that 32 bit microprocessor have high performance and power than 16 bit processor and low power consumption than 64 bit processors. The simulation shows that the processor executes for all the functional units. There is a scope in this 32-bit microprocessor that by increasing the no. functional units and instructions with an increased number of bits. [2]

REFERENCES

[1] Geetanjali and Nishant Tripathi ".VHDL Implementation of 32-Bit Arithmetic Logic Unit (Alu)" ICETIE 2012.
[2] Disha Malik and Richa Singh Rathore "32-bit Arithmetic Logical Unit (ALU) using VHDL" ISSN: 2348-4098.
[3] Technopedia, ALU, http://www.techopedia.com.
[4] Technopedia, ALU, http://www.techopedia.com.

