CMOS Performance Analysis of 4-bit Barrel Shifter

[1]Anjali Thakur, [2]Rajesh Mehra
[1]M. E Scholar, [2]Associate Professor
Electronics & Communication Engineering Department
National Institute of Technical Teachers Training & Research
Chandigarh, UT, India

Abstract : Barrel shifters are required for performing data shifting and rotation in computer operations from address coding to arithmetic computations. In this paper Barrel Shifter is designed. Two designs have been proposed namely fully automatic and semicustom. In first approach fully, automatic design inbuilt active are used along with auto routing and placement. In second approach, semicustom design inbuilt active devices are used along with optimized manual routing and placement. In fully automatic approach proposed schematic is design with DSCH and its equivalent layout is created using Microwind. In case of semicustom design, optimized layout is created with Microwind. It can be observed from simulated results that power is improved by 4.2 % and area is improved by 23 percent in case of semi-custom design as compared to fully automatic design.

IndexTerms **- Barrel shifter, digital circuit design. MUX, Power consumption, Time delay, VLSI**

I. INTRODUCTION

Barrel Shifter is an important component in arithmetic logic unit. It is used for logical shift left, logical shift right, arithmetic shift left, arithmetic shift right, rotate left and rotate right. It shifts data by defined no of bits using combinational logic. Barrel shifter can be implemented using MUX trees. Barrel shifter designed using MUX so as to consume less power. A typical use of barrel shifter is in the equipment usage of floating point number-implementation. For a float point include or subtract activity, the significands of the two numbers must be adjusted, which requires moving the more modest number to one side, expanding its type, until the point that it coordinates the example of the bigger number. This is finished by subtracting the examples and utilizing the barrel shifter to move the more modest number to one side by the distinction, in one cycle. In the event that a simple shifter was utilized, moving by n bit positions would require n clock cycles. The Barrel shifter are utilized in various DSP applications and in general purpose processors to manipulate the data. Barrel Shifter is circuit where n data inputs and outputs are utilized with control inputs that states the shifting of the input data bits. The n bit barrel shifter needs n bit multiplexers but. if n is increased the circuit complexity also increases, it requires more area and high-power consumption and it will affect the speed of the operation. [1-3].

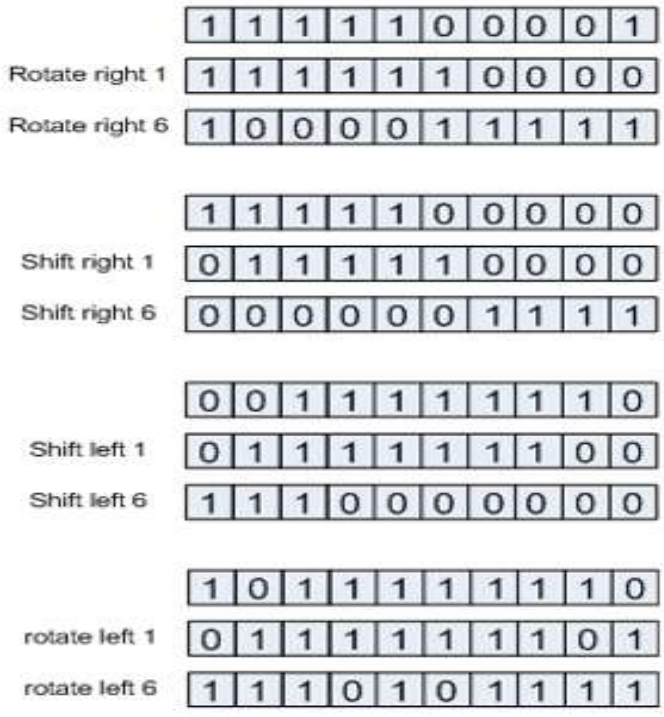


Fig.1 Shift operation of Barrel Shifter

The figure 1 shows the rotation of bits in right direction and in left direction by 1- bit and 6-bits shifting. The both types acquire one cycle to shift the bits. The pivot is a round move either to one side or left. It expresses that the bits are moved into the information vector on one side, they are moved to the information vector on the opposite side. The places of the bits can differ their positions in light of the fact that the bits are steering from contribution to the yield. The pivot activity is where the bit which

is moved out of the vector MSB is embedded at its LSB. The barrel shifters are required in general purpose processors and in digital processors. [4-5].]. Barrel Shifter is utilized for shifting operations in many processors as it takes one clock cycle to shift the data where as other shifting mechanisms used more clock cycles [6].

Arithmetical and Logical shifting is also done by using Barrel Shifter. In Logical shifting, bits were shifted left/right and empty places are filled with zeroes. In Arithmetic Shifting is same as logical shifting except in right shift the empty place is filled with MSB. Barrel Shifter can shift n bit in a single function /clock cycle. Barrel Shifter is known as Rotator as it rotates the data bits in a cycle in such a way that the empty spots are filled with the bits shifted from the other hand.

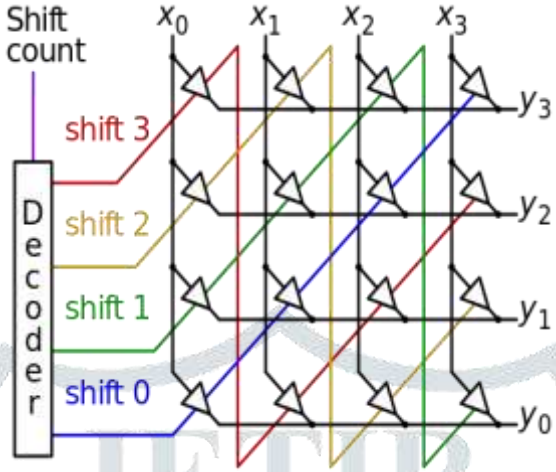


Fig 2 Schematic of 4x1 barrel shifter

Figure1 shows 4 bit cross bar barrel shifter. In this x denotes the input and y denotes the output. Decoder is used for shifting the its or to determine the no of bits to be shifted. Barrel shifter is a combinational circuit, utilizing traditional multiplexers and decoders. Barrel shifter designs demonstrate tradeoffs between silicon territory and speed of task .In this paper we represent the two designs ,fully automatic and semicustom and their comparison in area and power consumption.

II. BARREL SHIFTER

The 4-bit barrel shifter is designed in this paper using two different methods. The first method is standard cell-based design and the second method is semi-custom design in MICROWIND. In standard cell design we design 4x1 mux using 2x1 mux and design the barrel shifter in DSCH and compile the Verilog file in Microwind.

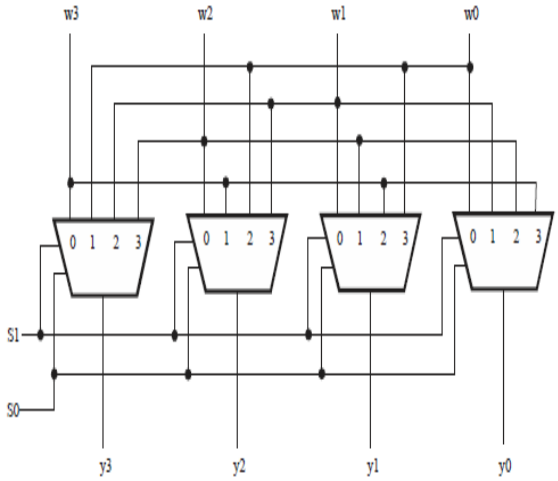


Fig 3 Design of 4-bit Barrel shifter using MUX

The design is simulated in dsch and the results were shown. The area and power consumed by this designed is analyzed. Barrel Shifter design using mux is used as it utilized low power consumption then other designs. Fig 2 shows the 4bit barrel shifter design. They are select lines of all mux are common, the w0, w1, w2, w3 are input bits to be rotated & y0, y1, y2, y3 are the shifted bits as output . The design composed of 4 inputs, two control inputs and 4 output pins, control inputs defines the bits to be shifted. In design Y defines output and W defines input bits. Here select lines defines how many bits are require to be shifted in the circuit

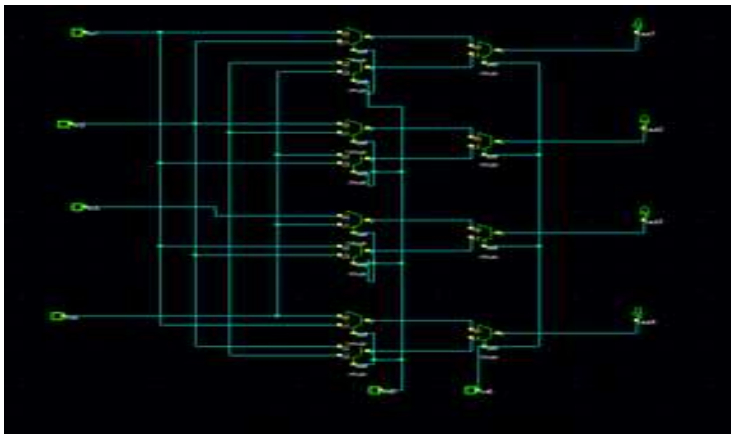


Fig 4Schematic of 4-bit Barrel shifter

Table1: Truth Table of 4 -bit Barrel Shifter

S_1	S_2	Y_3	Y_2	Y_1	Y_0
0	0	W_3	W_2	W_1	W_0
0	1	W_0	W_3	W_2	W_1
1	0	W_1	W_0	W_3	W_2
1	1	W_2	W_1	W_0	W_3

In the truth table S1 and S2 are control inputs defining the number of bits to be right shifted. If S1 =0, S2 =1, then bits are rotated by 1 bits. If S1 =1, S2 =0, then bits are rotated by 2 bits. If S1 =1, S2 =1, then bits are rotated by 4 bits.

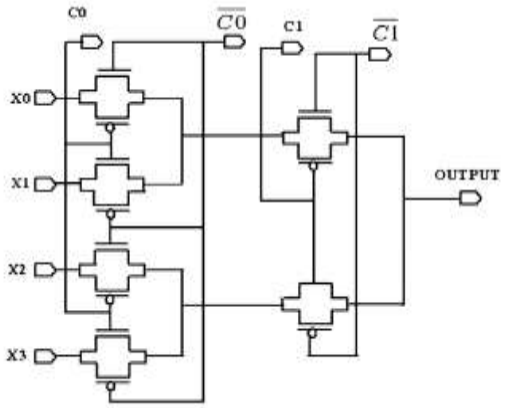


Fig 5 Transmission gate based 4:1 MUX

Fig 5 shows the transmission gate-based MUX utilized in implementing 4-bit barrel shifter [7,8] in microwind. This is model is used to implement the 4:1 mux in the microwind in semicustom design. Here x0, x1, x2, x3 are the inputs of mux, c0 and c1 are select lines and output is shown in figure in this paper this model is utilized to make the barrel shifter semi-custom design.

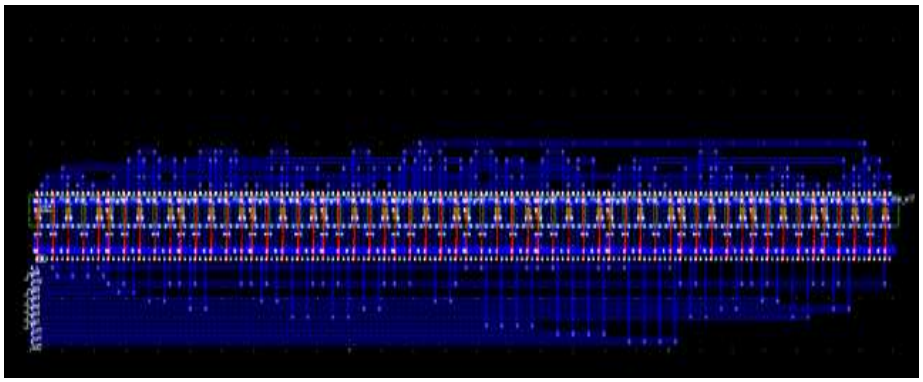


Fig 6 Layout of 4- bit Barrel Shifter

Fig 6 shows the fully automatic barrel shifter is implemented in microwind by compiling the Verilog file. This Verilog file is created in DSCH software and then compile in microwind Another method is semicustom design which is implemented in microwind using pmos and cmos transistors. Another approach is to make fully custom design by making nwell and pwell in the microwind. The fully custom design is efficient from other methods.

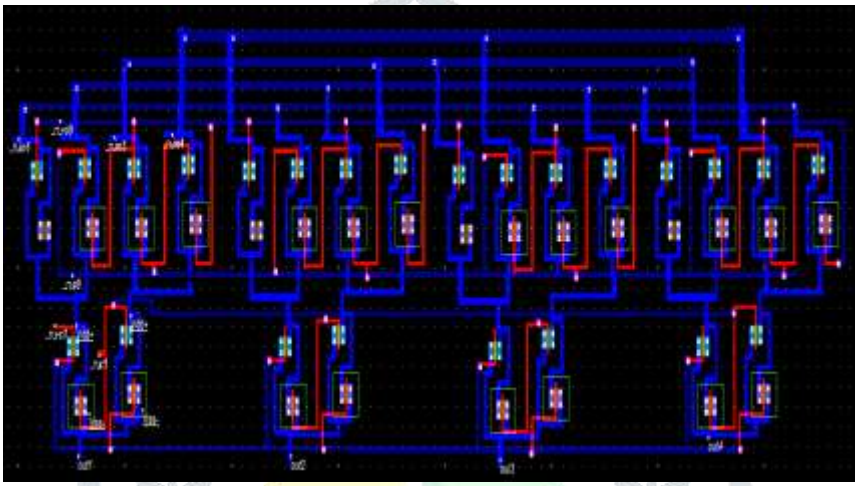


Fig 7 Semicustom Layout of 4-bit Barrel Shifter

The Semicustom design of 4-bit barrel shifter is simulate and results are analyzed from both designs.

III. SIMULATION AND RESULTS

The simulation of both designs was analyzed

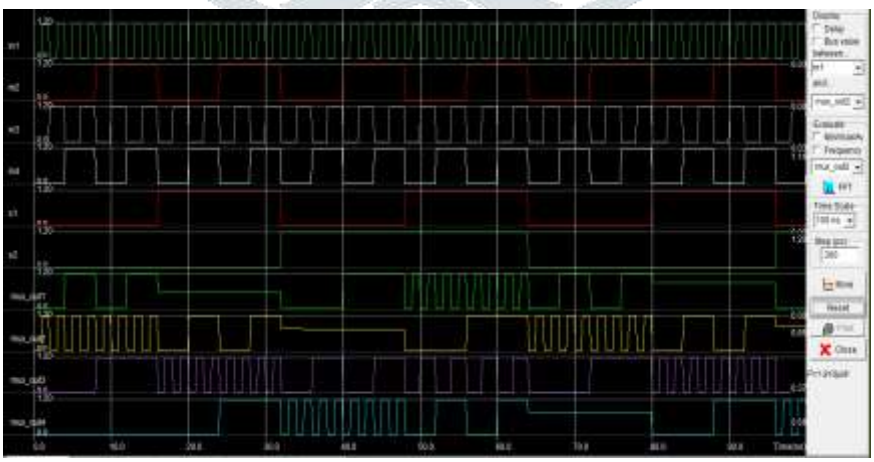


Fig 8 Simulation of Autogenerated Barrel Shifter

Fig 8 shows waveform of output timing generation of autogenerated Barrel Shifter. The CMOS 0.12μm technology is utilized. The area of the autogenerated barrel shifter is 961μm2. The Power is 1.9μW in the autogenerated Barrel Shifter.

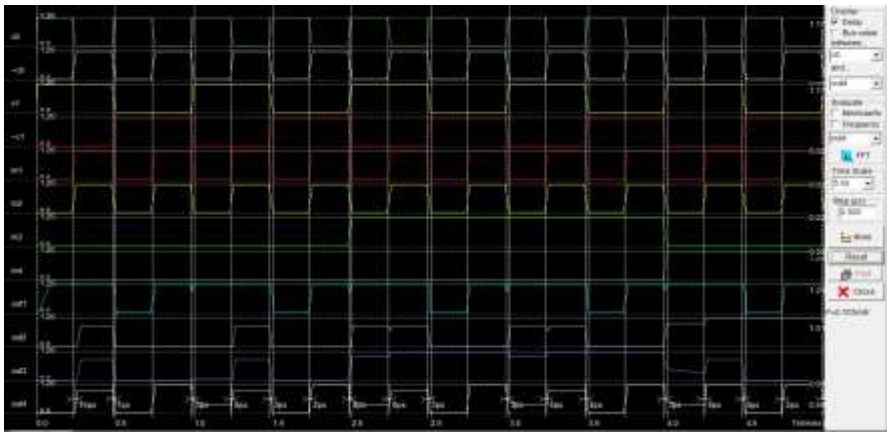


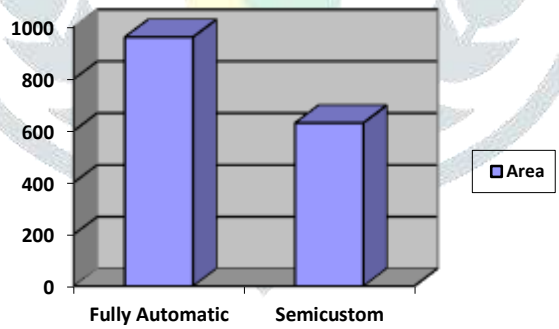
Figure 10 Simulation of Semi-Custom barrel shifter

Fig10 shows waveform of output timing generation of Semicustom Barrel Shifter. The CMOS 0.12μm technology is utilized. The area of the barrel shifter is 630μm2. The Power is 1.82μW in the semicustom Barrel Shifter

IV. COMPARITIVE ANALYSIS

Table 2: Result Comparison of designs

S. No	Design	Area(μm2)	Power(μW)
1	Fully Autogenerated	961	1.9
2	Semicustom	630	1.82



The bar graph shows the reduction in area of semicustom design as compared to autogenerated design of 4-bit barrel shifter.

V. CONCLUSION & FUTURE SCOPE

This paper presents a comparison between autogenerated and semicustom design of 4-bit Barrel Shifter. The semicustom design acquires less area as compared to the autogenerated design. The reduction in area is 35 percent less in semicustom design. With respect to area and power consumption, the semicustom design is preferable.

V1. ACKNOWLEDGMENT

The authors would like to thank the Director, National Institute of Technical Teachers' Training & Research, Chandigarh, India for continuous support throughout this research work.

REFERENCES

[1] V. Elamaran and Har Narayan Upadhyay"Low Power Digital Barrel Shifter Datapath Circuits Using Microwind Layout Editor with High Reliability" Asian Journal of Scientific Research 8 (4): 478-489.

[2] Abhijit Asati and Chandrashekhar "VLSI Implementation of a High Performance Barrel Shifter Architecture using Three Different Logic Design Style" International Journal of Recent Trends in Engineering, Vol 2, No. 7, November 2009.
[3] Akhilesh Verma, Rajesh Mehra, "Design and Analysis of Conventional and Ratioed Cmos Logic Circuit" IOSR Journal of VLSI and Signal Processing Vol.2, pp. 25-29, April 2013
[4] Priyanka Aggarwal, Dr. Rajesh Mehra" Design and Performance Analysis of Barrel Shifter Using 45nm Technology "IOSR Journal of VLSI and Signal Processing (IOSR-JVSP) Volume 6, Issue 3, Ver. I (May. -Jun. 2016)
[5] Prasad D Khandekar, ShailaSubbaraman and Venkat Raman Vinjamoori, "Quasi-Adiabatic 2X2 f Shifter," 4th International Conference On Industrial and Information Systems ,28-31 December 2009, pp.321-324. ICIIS-2009
[6] Shilpa Thakur, Rajesh Mehra "CMOS Design and Single Supply Level Shifter Using 90nm Technology" Conference on Advances in Communication and Control Systems, pp.150-153, 2013.
[7] JyotiSankarSahoo, Nirmal Kumar Rout, "Comparative Study on Low Power Barrel Shifter/Rotator at 45nm technology," International Journal of Advanced Engineering and Nano Technology(IJAENT), Vol.2 Issue 6, pp.11-18, May 2015
[8] G.M.Tharakan, S.M.Kang, "A New Design of a Solid State Circuits, Vol.28, pp.217221, February 1992