Ahsanullah University of Science & Technology

Department of Computer Science & Engineering

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Introduction:

In this experiment, a 5x5 Booth Multiplier is designed by the help of Booth's algorithm. Booth's algorithm has two criteria which are —

1) Fast Multiplication
2) Signed Multiplication

Booth's algorithm provides procedures of multiplying binary integers in signed 2's compliment representation in an efficient way in which less number of additional subtraction is required. Whenever the multiplier has strings of (00 or 11), it requires only shifting without any addition. Again if the multiplier has strings of (01 or 10) from bit weight 2^k to weight 2^m can be treated as $2^{1(k+1)}$ to 2^{1m}, this algorithm follows the method of repeatedly adding one of the two pre-determined values (A & S) to the product P; after that a right arithmetic shift is being performed on P.

Problem Statement:

Design a 5×5 Booth Multiplier

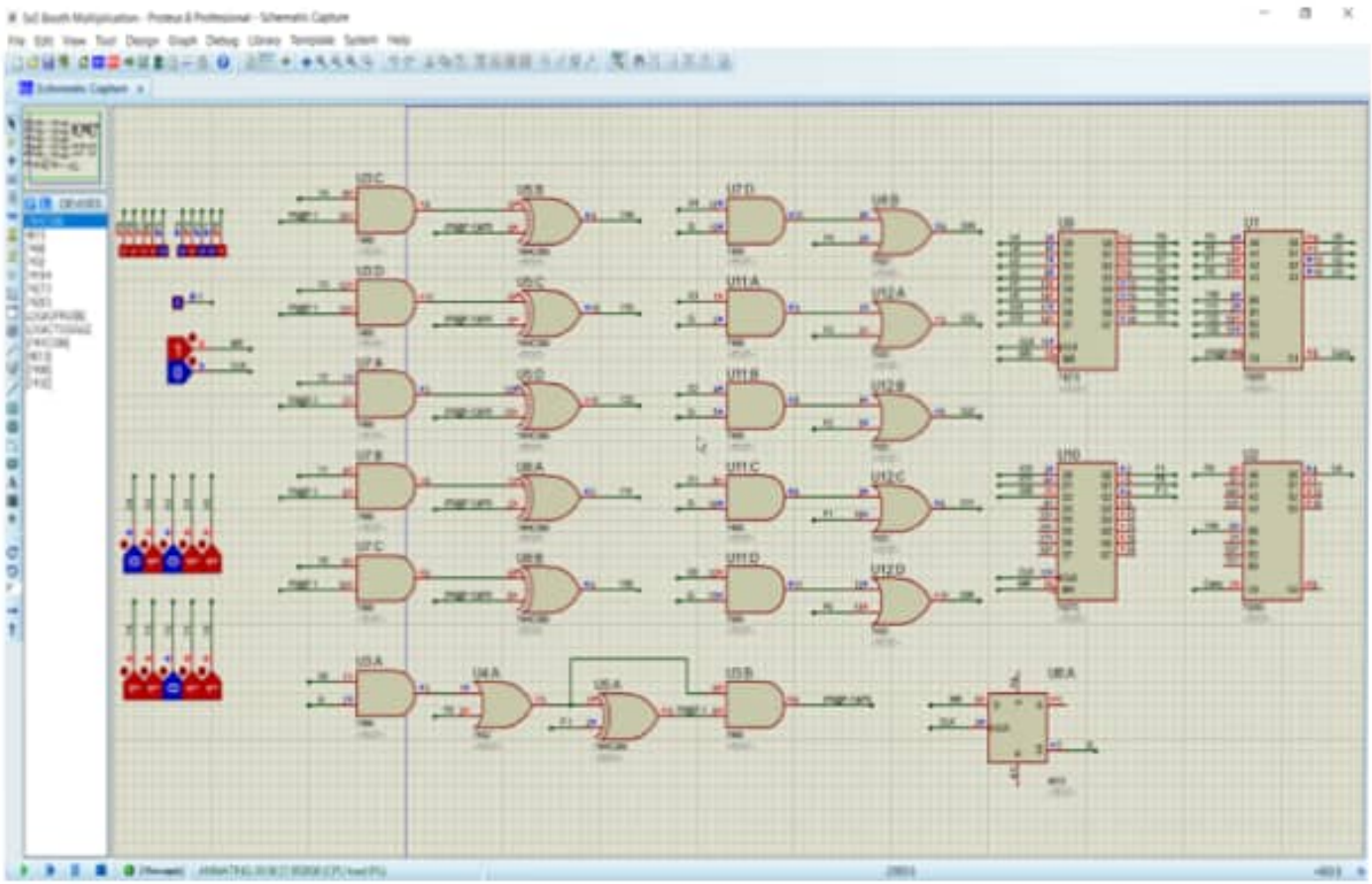
ALU Operation:

S_1	S_0	Operation
0	0	$u+0$
0	1	$u+y$
1	0	$u-y$
1	1	$u+0$

Equipment and Budget:

Gate	IC number	Quantity	Price per IC (tk)	Total (tk)
AND	7408	12	23	276
OR	7432	6	27	162
XOR	7486	6	24	144
4 bit Adders	7483	2	40	80
D Flip-flop	4013	2	20	50
			Total cost = 712 taka	

Simulation:



Result :

Find $11 \times (-5)$ using Booth's Algorithm with $m = 11$,

$r = -5, \quad x = 5, \quad y = 5$

Here,

$$x = 11 = 01011$$

$$y = (-5) = 11011$$

$$-y = 5 = 00101$$

The initial values of u, v, x_{-1} will be 0.

Step	u	v	x	x_{-1}
	00000 00101	00000	01011	0
Step-1	00101 00010 00000	00000 10000	01011 00101	0 1
Step-2	00010 00001 11011	10000 01000	00101 00010	1 1
Step-3	11100 11110 00101	01000 00100	00010 00001	1 0
Step-4	00011 00001 11011	00100 10010	00001 00000	0 1
Step-5	11100 11110 (-55)	10010 01001	00000 00000	1 0

∴ The result is $(u+v) \Rightarrow$ 11110 01001 $= (-55)$

Conclusion:

In this experiment, we have implemented the Booth's Algorithm. As per the algorithm, we have initialized the value of u, v and x_{-1} as zero and x with the multiplicand. In our experiment, we have taken $(11)_{10}$ as multiplicand and $(-5)_{10}$ as multiplier. The result is 2s complement of $(55)_{10}$ which is shown in the output. That means our circuit of booth's algorithm works perfectly.