

EFFICIENT VEDIC MULTIPLIER

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ABSTRACT

Multiplier is one important block in the digital signal processor, computer. There are various multiplier architectures are present, but in that simple multiplication is done using vedic mathematics through vedic multiplier. Vedic multiplier uses vedic mathematics such as Urdhva Triyakbhyam and Nikhilam sutra. Using that multiplier we have low power consumption, low delay and high speed. Which has become one of the important key area in VLSI design using CMOS challenging technology.

KEYWORDS: Multiplier, Wallace Tree, Vedic Multiplier, Nikhilam and Urdhva Triyakbhyam Formula, CMOS Layout Technology

INTRODUCTION

For performing larger number mathematical calculation in less time is one of the important operation. But multiplication spent more time to perform its calculation, so there is requirement of high speed, low delay and low power consumption multiplier is important in the digital signal processors [1][2]. This type of multiplier provides high performance and low power dissipation in digital signal processing system [3]. To achieve this various types multiplier are designed [4] [5], but in that vedic multiplier is very simple and provide high speed, low power consumption operation.

VEDIC MATHEMATICS

“Vedic” word is derived from “Veda”. There are sixteen formulae in vedic mathematics. Meanings of these formulae is as follows

Table 1: Meaning of the Vedic Formula [6]

Sr.No.	Formula	Meaning
1	Anurupye or Shunyamayant	If one is in ratio, other is zero
2	Chalana-Kalanbhyam	Differences and similarities
3	Ekdhikina Purvena	By one more than the previous one
4	Ekanyunena Purvena	By one less than the previous one
5	Gaunakasamuchyah	The factors of sum is equal to sum of the factors
6	Gunitasamuchyah	The product of the sum is equal to the sum of product
7	Nikhilam Navatashcaramam dashatah	All from 9 and last from 10
8	Paraavartya Yojayet	Transpose and adjust
9	Puranapurabhyam	By the completion or non-completion
10	Sankalana-Vyavakalanabhyam	By addition and by subtraction
11	Shesanyankena Charmena	The remainders by the last digit
12	Shunyam Saamyasamuccaye	When the sum is same that sum is zero
13	Sopaanyadvayamantyam	The ultimate and twice the penultimate
14	Urdhva Triyagbhyam	Vertically and crosswise
15	Vyashτισamanstih	Part and whole
16	Yaavadunam	Whatever the extent of its efficiency

Urdhva Triyakbhyam Formula

The word ‘‘Urdhva’’ means ‘‘vertically’’ and ‘‘Triyakbhyam’’ means ‘‘crosswise’’. Urdhva Triyakbhyam formula is applicable for each cases of multiplication. Multiplication using Urdhva Triyakbhyam which is shown in figure 1 mathematically.

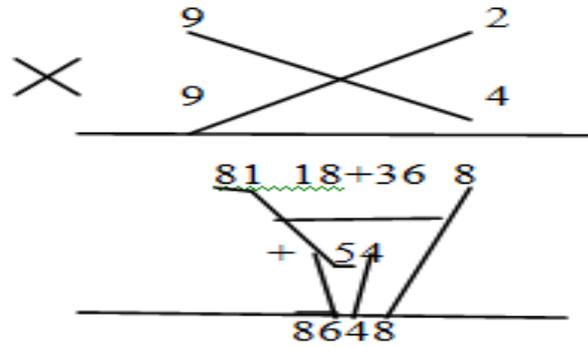


Figure 1: Multiplication Using Urdhva Triyakbhyam Formula

In this multiplication here we require four multiplier and one adder.

This formula is also used in binary number system also like as shown in figure1.

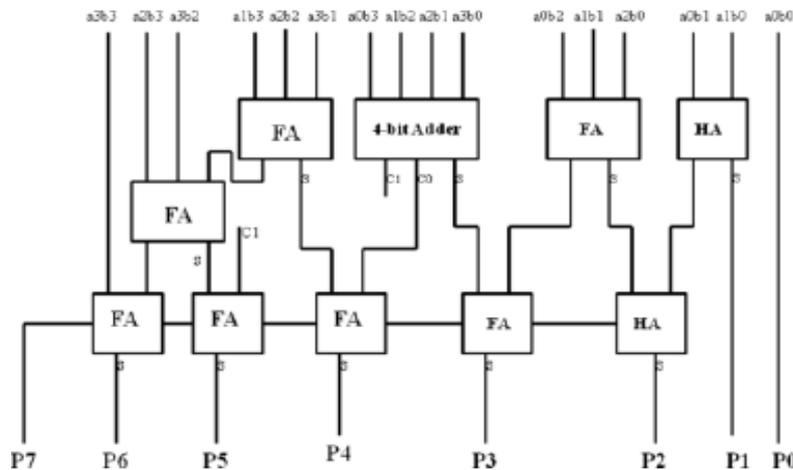


Figure 2: Block Diagram of Vedic Multiplier Using Urdhva Triyakbhyam Formula

Nikhilam Formula

It is efficient when the number is large. Meaning of Nikhilam formula is ‘‘all from 9 and last from 10’’.

Multiplication is done using Nikhilam formula. The steps of the multiplication is as follows

- First finding complement of multiplier and multiplicand.
- Then making two columns of numbers, one column consisting of the number to be multiplied and second column consisting of their complements.
- In the final answer making one vertical line which gives, In RHS of product, the product of their complements and in LHS of product, multiplier or multiplicand subtracts the complement of multiplicand or multiplier respectively.
- In this way we get final product. These are shown in figure3. And its block diagram through that steps is shown in figure4.

Nearest Base= 100

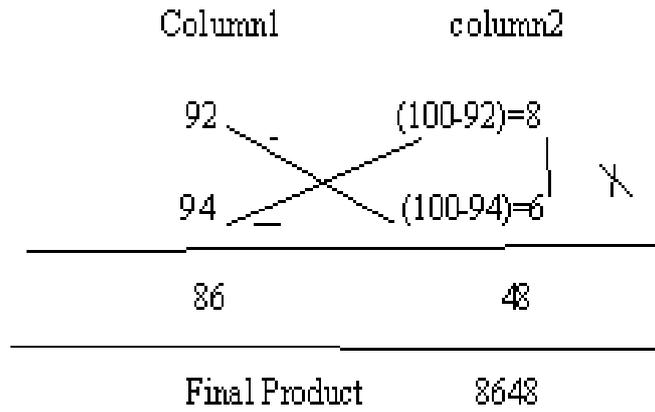


Figure 3: Multiplication of Two Number Using Nikhilam Formula

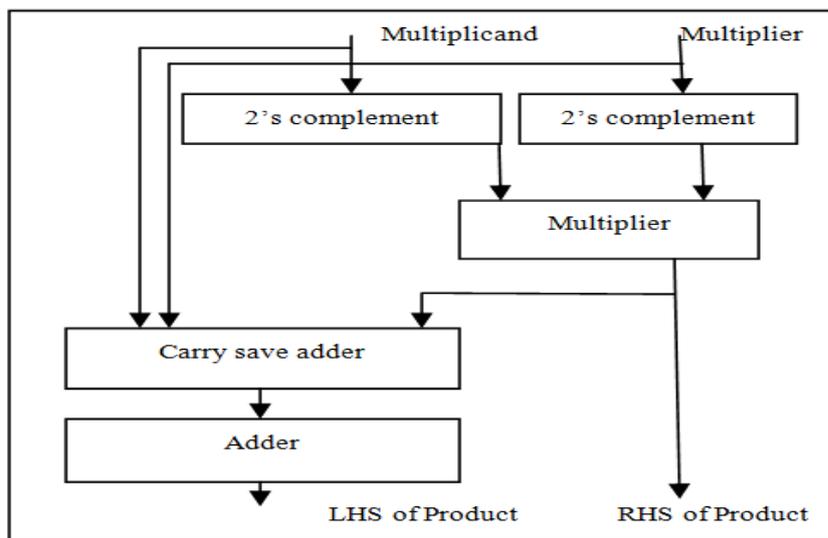


Figure 4: Block Diagram of Vedic Multiplier Using Nikhilam Formula

LAYOUT OF DIFFERENT MULTIPLIER

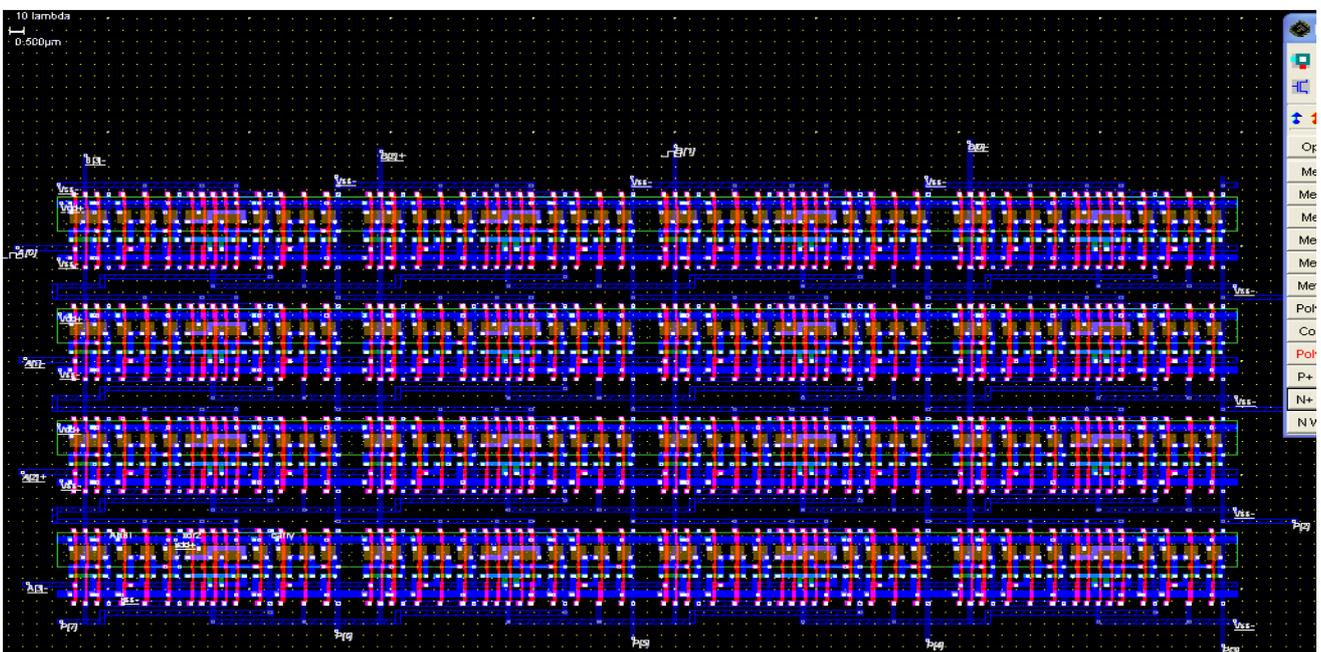


Figure 5: Layout of Simple Multiplier

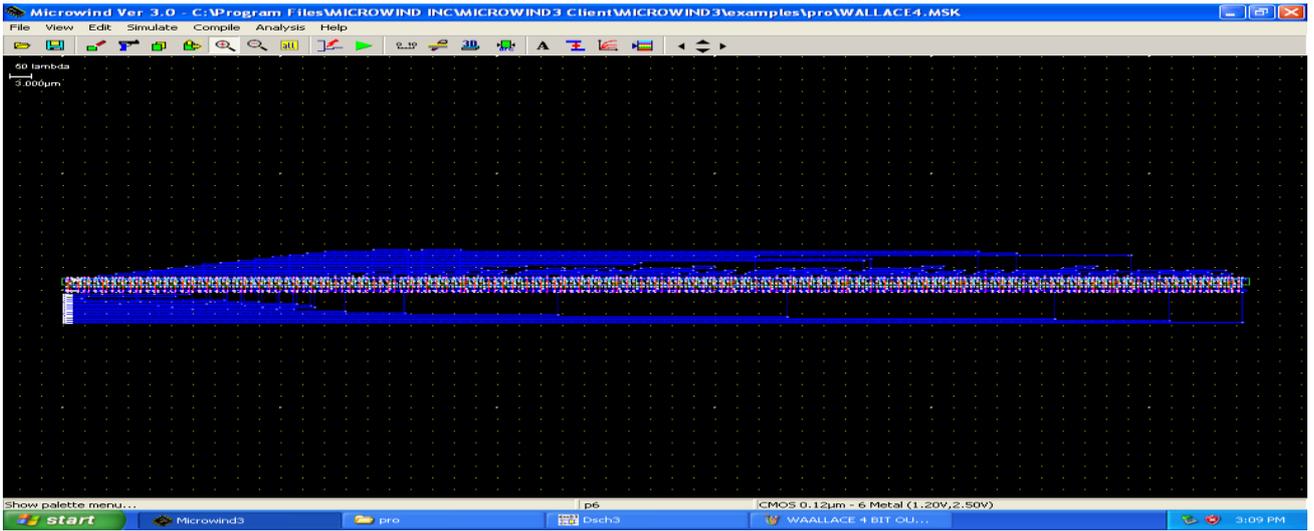


Figure 6: Layout of Wallace Tree Multiplier

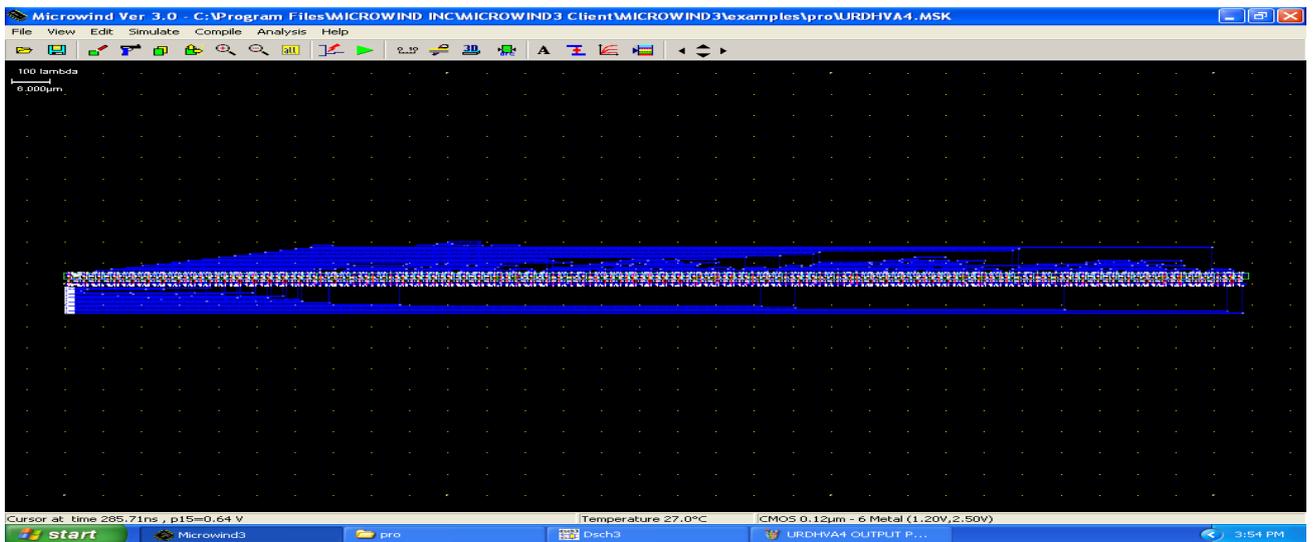


Figure 7: Layout of Multiplier Using Urdhva Triyakbhyam Formula

SIMULATION

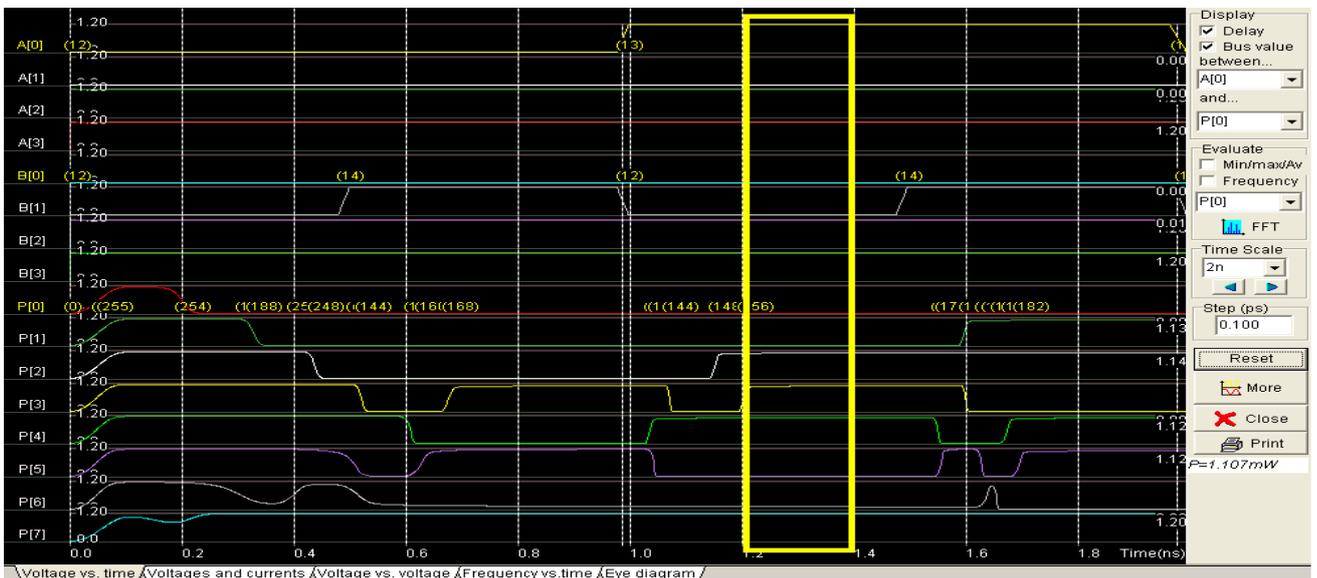


Figure 8: Simulation Result of 4 Bit Simple Multiplier

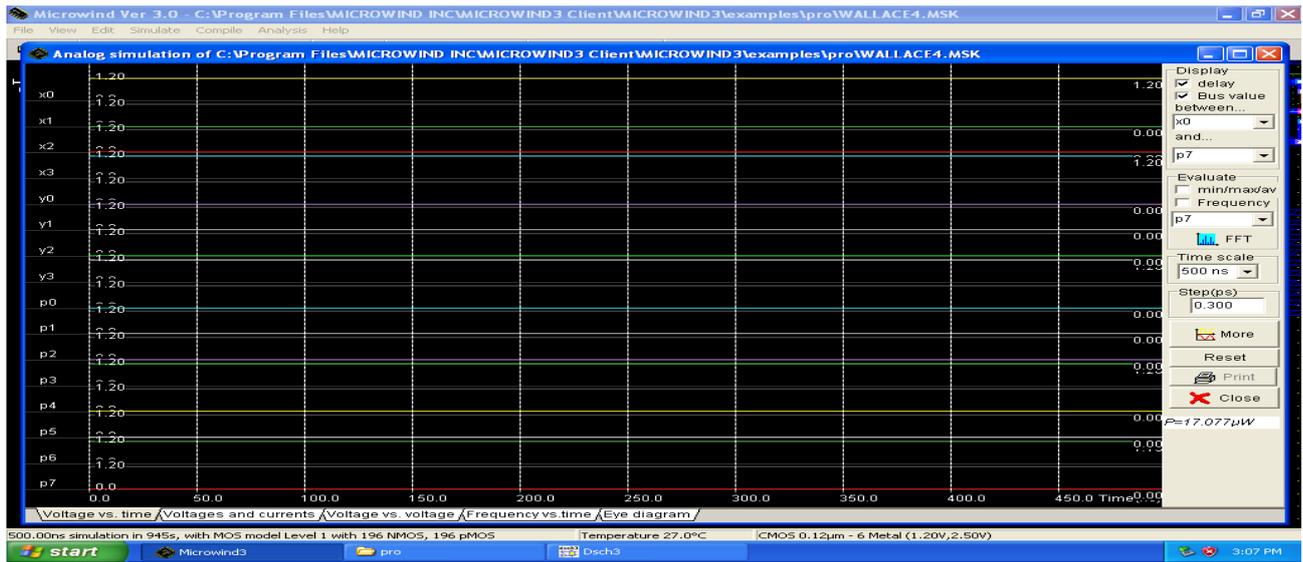


Figure 9: Simulation Result of 4 Bit Wallace Tree Multiplier

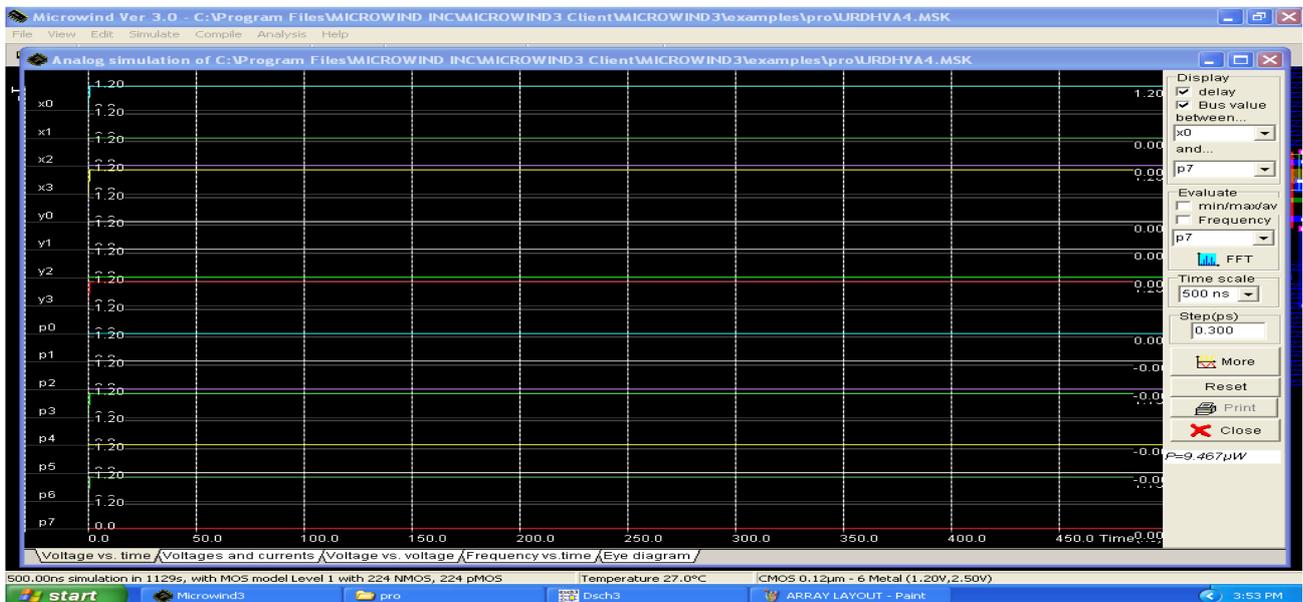


Figure 10: Simulation Result of 4 Bit Vedic Multiplier Using Triyagbhyam Formula

RESULTS

Table 2: Comparison of Simulation Result of Various Multiplier

Sr.No.	Types of Multiplier	Size	Power
1	Simple multiplier	4 bit	1.07milliwatt
2	Wallace Tree Multiplier	4 bit	17.077microwatt
3	Vedic Multiplier using Urdhva triyagbhyam formula	4 bit	9.467microwatt

CONCLUSIONS

The proposed vedic multiplier is used for multiplication of two numbers with low power in DSP applications. To implement high performance multiplier in DSP the power of 4 bit multiplier must be minimum. Using simulation results we have decided that vedic multiplier consume low power compared with Wallace tree multiplier. Vedic multiplier is implemented using vedic mathematics (which is simple in understand). Smaller bit vedic multiplier is used to implement higher level multipliers. So vedic multiplier is efficient.

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