Design of 16 x 16 Multiplier Using Vedic Mathematics

Smita Sharan [1], Pankaj M. Gulhane [2]
[1]M.Tech Scholar, DIMAT Raipur (CG), smitasharan26@gmail.com, India;
[2] Assistant professor, DIMAT Raipur (CG), pankaj.gulhane@dishamail.com, India;

Abstract— **The need of low area and high speed Multiplier is increasing as the need of high speed processors are needed. Vedic arithmetic is that the traditional system of arithmetic which has a novel technique of calculations supported sixteen Sutras that are discovered by Sri Bharti Krishna Tirthaji. Any processor's performance depends on 3 vital factors specifically speed, space and power. A higher trade-off between these factors makes the processor, a good one. Multipliers are the usually used architectures within the processor. If the performance of those multipliers is improved then powerful processors is created in future. During this work, the planned number style supported the sutra- 'Urdhva Tiryakbhyam' of Vedic arithmetic is analyzed and also the performance results of the number are compared with standard multipliers. Extremely economical arithmetic operations are necessary to appreciate the specified performance in several periods of time systems and digital image method applications. Altogether these applications, one of the necessary arithmetic operations of performed is to multiply and accumulate with a little method time (delay). The multipliers used in Square and cube architecture have to be more efficient in area and also in speed.**

Keywords— **Vedic multiplier, Array Multiplier, Vedic Mathematics, Urdhva-Tiryagbhyam,**

I. INTRODUCTION

Real time digital signal processing today involves rigorous multiplication operations, which increases the computational complexity of modern day signal processors. The performance of such processors largely rests on the effectiveness of the multiplier units embedded within. A typical multiplier block comprises of a chain of AND gates to generate the partial product terms and an adder assembly to add them. The speed limitation associated with conventional multiplier architectures is largely due to the latency introduced by long adder tree structures. The power consumption of a multiplier unit is also a major design concern. Several research works have been reported over the years to optimize the performance of multiplier topologies. The basic approaches are to reduce the switching activity of the partial products [1], to reduce the number of nonzero partial product terms by effective encoding of the multiplier inputs and to realize a high speed adder tree for fast addition of the partial products. The Booth encoded multiplier topology [2, 3], Wallace tree based multiplier design [4-5] and compressor based multiplier architecture have provided noticeable performance enhancement over the conventional array multiplier. However the use of Vedic mathematics for multiplication [6-10] resulted in significant improvement in the overall speed and power consumption of a multiplier topology, due to the parallel computing approach.

They are four types of ancient mathematics, the Vedas and Vedic mathematics is one of part the four Vedas. The Atharva Veda is a UPA-Veda (appendix), the Sthapatya-Veda (Civil engineering and construction of the book), and part of the atharva Veda. Arithmetic, trigonometry geometry (plane, coordinate), quadratic equations, calculus factor, and also including the description applies to many modern mathematical terms are explained in this atharva Veda [6].

His Holiness jagadguru Shankaracharya Bharati Krishna Teerthaji Maharaja (1884 −1960 comprised all this work together and gave its mathematical explanation while using it for various applications. After thorough research in Atharva Veda, swahij described 16 sutras (formulae) and 16 upa sutras (sub formulas). In present text of Atharva Veda these formulae are not found because these formulae were implemented by Swamiji himself [6]. Vedic mathematics is a mathematical miracle, but it is also logically. That is the reason why Vedic mathematics has such a degree of fame. Because of this unusual characteristic, Vedic mathematics has already crossed the boundaries of India and became the upcoming topic of research. Several basic and complex multiplications can be easily solved by Vedic mathematic.They are many basic methods in vedic mathematics for arithmetic, which are very simple and effective.

The word "Vedic" is derived from the Sanskrit word "veda" which means the wisdom. The branches of maths like geometry, arithmetic, algebra, etc are solved by Vedic mathematics by using the 16 sutras.

II. THEORY

A. Vedic Mathematics

The The Vedic arithmetic is a component of four Vedas (books of wisdom). it's a part of Sthapatya- Veda (book on civil engineering and architecture), that is an upa-veda (supplement) of Atharva Veda. It covers explanation of many modern mathematical terms as well as arithmetic, geometry (plane, co-ordinate), trigonometry, quadratic equations, factorization and even calculus. His quality Jagadguru Shankaracharya Bharati Krishna Teerthaji maharajah (1884-1960) comprised all this work along and gave its mathematical explanation whereas discussing it for numerous applications. Swahiji made 16 sutras (formulae) and 16 Upa sutras (sub formulae) once extensive analysis in Atharva Veda. Obviously these formulae aren't to be found in present text of Atharva Veda as a result of these formulae was made by Swamiji himself. vedic arithmetic isn't only a mathematical wonder however additionally it's logical. That's why VM has such a degree of eminence that can't be disapproved. Due these phenomenal characteristic, VM has already crossed the boundaries of India and has become a number one topic of analysis abroad. VM deals with many basic further as complicated mathematical operations. Especially, ways of basic arithmetic are very simple and powerful. The word „Vedic" is derived from the word „Veda" which implies the store-house of all data. vedic arithmetic is principally based on 16 Sutras (or aphorisms) addressing numerous branches of arithmetic like arithmetic, algebra, geometry etc.

The word vedic is derived from Sanskrit word veda which implies to know while not limit. The word Vedic literature covers all Veda-sakhas known to humanity. There are four Vedas: The Rig-Veda, The Yajurveda, The Samaveda, and also the Atharvaveda.

Swami Bharati Krishna Tirtha (1884-1960), former Jagadguru Sankaracharya of Puri culled a group of 16 Sutras (aphorisms) and 13 Sub - Sutras (corollaries) from the Atharva veda [1,9]. He developed strategies and techniques for amplifying the principles contained within the aphorisms and their corollaries, and referred to as it Vedic arithmetic.

Nikhilam Navatashcaramam Dashatah Sanskrit literature and Urdhva–Tiryagbhyam Sanskrit literature are 2 sutras used for multiplication. Urdhva–Tiryagbhyam Sanskrit literature that is applicable to all or any cases of multiplication and conjointly for the division of enormous variety by another large number.

III. PROPOSED METHODOLOGY

A. Multiplication Using Nikhilam Sutra

Nikhilam sutra factually means that "all from 9 and last from 10". though it's valid to any or all cases of multiplication, it's additional capable once the numbers concerned are huge. Since it checks out the compliment of the large range from its adjacent base to perform the multiplication operation on that, higher is the original range, lesser the complexness of the multiplication.

Nikhilam sutra stipulates subtraction of variety from the closest power of 10 i.e. 10, 100, 1000, etc. the ability of 10 from that the difference is calculated is named the base. These ranges are thought of to be references to find out whether given number is less or over the base. If the given range is 104, the closest power of 10 is 100 and is that the base. Thus the difference between the base and also the range is 4, that is Positive and it's known as NIKHILAM.

Procedure for implementation number using Nikhalam sutra: NIKALAM PROCEDURE for DECIMAL calculation: Follow the procedure as done in KCM and at last divide the LSB and MSB half keep the LSB half because it is and when carry save adder addition multiply with a hundred to MSB worth if is 2-digit range (or) multiply with 1000 if it's 3-digit worth then on.Fig.1show is diagram of 16x16 vedic number using BEC.

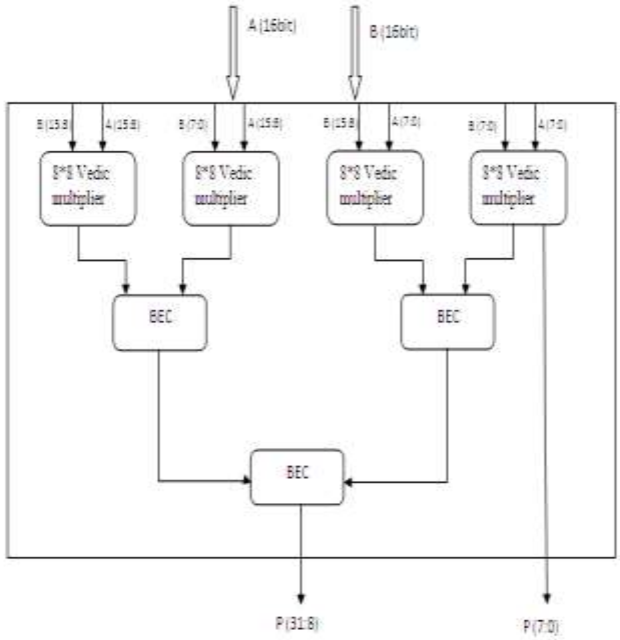

Fig.1 Block diagram of 16x16 Vedic multiplier using BEC

B. KCM Multiplier

The proposed method is based on ROM approach however both the inputs for the multiplier can be variables. In this proposed method a ROM is used for storing the squares of numbers as compared to KCM where the multiples are stored.

Method: To find (a x b), first we have to find whether the difference between 'a' and 'b' is odd or even. Based on the difference, the product is calculated.

- In case of Even Difference

Result of Multiplication= [Average] 2- [Deviation] 2

- In case of Odd Difference Result of

Multiplication = [Average x (Average + 1)] - [Deviation x (Deviation+ 1)]

Where, Average = [(a+b)/2] and Deviation = [Average -smallest (a, b)]

The two variable multiplications are performed by averaging, squaring and subtraction. To find the average [(a+b)/2], which involves division by 2 is performed by right shifting the sum by one bit. If the squares of the numbers are stored in a ROM, the result can be instantaneously calculated. However, in case of Odd difference, the process is different as the average is a floating point number. In order to handle floating point arithmetic, Ekadikena Purvena - the Vedic Sutra which is used to find the square of numbers end with 5 is applied. Example 5 illustrates this. In this case, instead of squaring the average and deviation, [Average x (Average + 1)] - [Deviation x (Deviation+ I)] is used. However, instead of performing the multiplications, the same ROM is used and using equation (10) the result of multiplication is obtained.

IV. RESULT

All simulation result and circuitry are presented for the proposed model is in this chapter, in high speed multiplier code was synthesized using XILINX and simulation results are shown below:

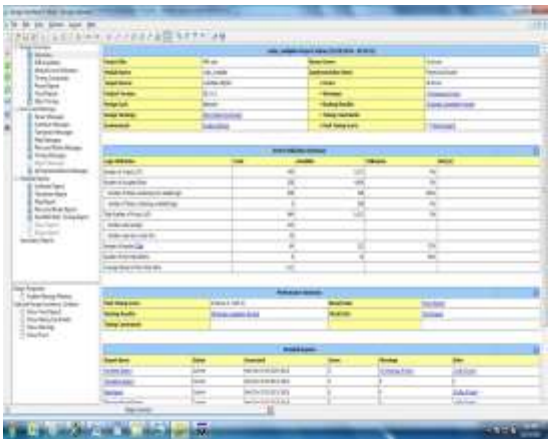

Fig.2 Synthesize report of proposed system

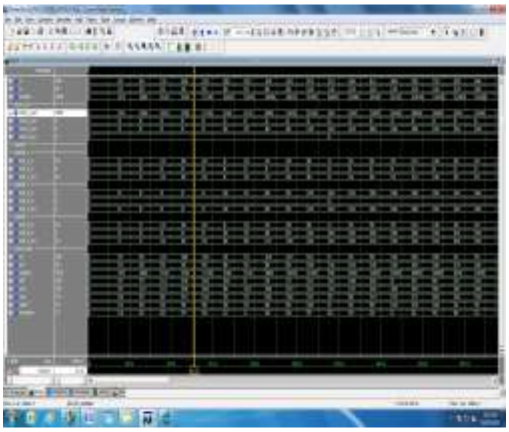

Fig.3 Simulation output of proposed system

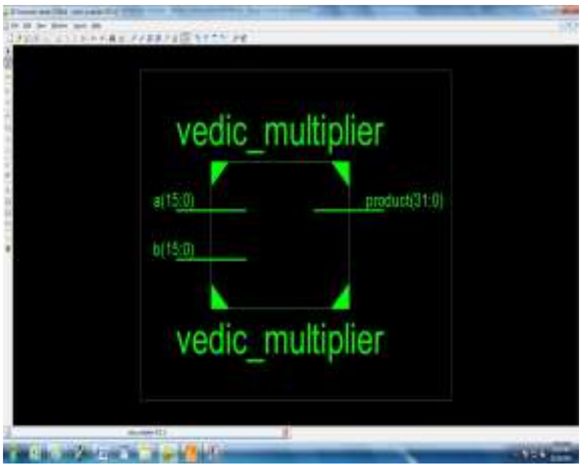

Fig.4RTL view of vedic multiplier

Fig.5 Power report of proposed system

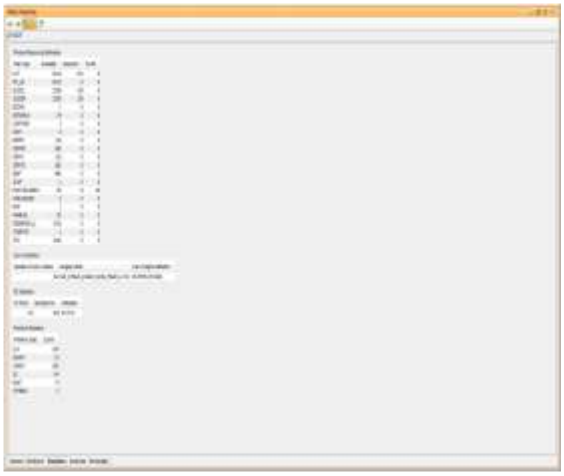

Fig.6 Area report of proposed system

V. CONCLUSION

Thus the projected number provides higher performance for higher order bit multiplication. This is often in the main because of memory constraints. Effective memory implementation and deployment of memory compression algorithms will yield even higher ends up in terms of space and speed that improves the general performance of the planning. Nikhilam sutra based mostly vedic number with BEC is highly efficient algorithmic rule for multiplication. This is often in the main because of memory constraints.

Effective memory implementation and deployment of memory compression algorithms will yield even higher results. We have explored the chance of applying the Nikhilam sutra of vedic arithmetic to binary variety multiplication. We will take advantage of the very fact that this sutra can convert large-digit multiplication to corresponding little digit multiplication. Nikhilam methodology is especially efficient once each number and number is near to some base (radix) power.

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