

A High-Speed And Energy-Efficient Roba Multiplier Using LF Adder

¹ NARAYANAM ROJA NAGAJYOTHI, ² A. ANCIA

¹M.Tech student, Dept of ECE, Malineni Perumallu Educational Society's Group of Institutions, Guntur, AP, India

²Assistant Professor, Dept of ECE, Malineni Perumallu Educational Society's Group of Institutions, Guntur, AP, India

ABSTRACT: *Approximate circuits are becoming an effective solution to accurately operating circuits if energy efficiency is concerned and the application is error tolerant. In this paper an approximate multiplier which is based on rounding is designed using the Ladner Fischer adder. The Ladner Fischer adder is one of the parallel prefix adders which greatly reduce the consumption of area for higher order bits. In this paper, we propose an approximate multiplier that is high speed yet energy efficient. The approach is to round the operands to the nearest exponent of two. This way the computational intensive part of the multiplication is omitted improving speed and energy consumption at the price of a small error. The proposed approach is applicable to both signed and unsigned multiplications. This proposed approximate multiplier has less delay and consumes less area and its efficiency is compared with those some of previous approximate and accurate multipliers in terms of area and delay.*

Keywords: approximate multiplier, Ladner Fischer adder, less area, high efficient.

I.INTRODUCTION

High level security, adoptable to various application, proficient and exportable are the targets of AES. To peruse an encoded message of AES a decent symmetric key calculation like AES should exists with no assault superior to key fatigue. During the time spent Encryption or Cipher, the information and the information key were duplicated to the State cluster utilizing the

traditions. So at first the XOR task is performed between every byte of the information and the information key and the yield ought to be given as the contribution of the Round-1. After the procedure of an underlying Round Key expansion, the State exhibit is changed by actualizing a round capacity multiple times. So with the last round it can acquire yield from Nr- 1 rounds.

Finally the last State is duplicated to the yield. By utilizing round capacity, the procedure is parameterized which comprises of a one- Dimensional cluster of four-byte words. These are determined by utilizing the Key Expansion schedule.

In step with Moore's regulation, the variety of transistors on a chip doubles nearly each years. As an end result, extra capabilities and greater complicated designs can be applied on one chip, which ends up in extra power density and greater warmth at the circuits. Better electricity density at the circuit reduces the reliability of the gadget and the battery lifestyles of the battery-primarily based gadgets. Therefore, electricity and strength consumptions of the circuit gain gives probably extra importance than region. Especially for maximum compact portable gadgets that work by battery. Nowadays, lots of information are exchanged via networks, as a consequence offering protection offerings over networks is important for defensive data. Amongst safety technologies, public key cryptography is famous and critical. Binary extension discipline, is very appealing for hardware implementation,

because it offers bring loose arithmetic. Multiplication operation has been paid most attention by using researchers, due to the fact addition is simply bitwise XOR operation among two subject elements, and the extra complex operations, inversion, and may be done with a few multiplications. In RoBA multiplier there are numerous strategies to represent field factors, which include polynomial foundation (PB), everyday basis, and dual basis. PB is probably the most popularly used foundation, because it is followed as one of the basis selections by using companies that set requirements for cryptography programs. The utilization of approximate multipliers in image preparing applications, which prompts decreases in power utilization, deferral, and transistor check contrasted and those of a correct multiplier configuration, has been examined in the writing.

Basically, our focus is on digit-level architectures for RoBA multipliers. We show that a specific feature of redundant representation can be used for a class of finite fields to significantly reduce the architectural complexity of RoBA multipliers to compensate for the inherent redundancy in this representation system. Two variants of multiplication algorithms along with their corresponding architecture are presented. It is shown that the proposed architectures have highly regular structures and thus suitable for hardware implementation. Comparisons with existing digit-level RoBA architectures reveal that both the proposed architectures outperform other RoBA architectures when considering area-delay product as a measure of performance

The idea of embedding a field in a larger ring was first put forward by GAO Et Al. for performing fast multiplication using RoBA. Later on, Wu *et al.* introduced redundant representation, also known as

RoBA, and finite field multiplication using this representation system. In endeavors to increase the augmentation speed or to lessen the equipment complexities, a few designs have been proposed a short time later, for example, combo style engineering and inear feedback Shift register (LFSR)- based structures. All the more as of late, Xie et al. proposed a recursive decay plot for digit-level sequential/parallel structures to accomplish less area– time– control complexities. In spite of the structure of the engineering being used, the fundamental downside of repetitive portrayal is that it contains a specific measure of excess as implanting field F_{2^m} of size m in cyclostome field $F(n)_2$ of size n , ($n > m$), is certifiably not a coordinated mapping task. Subsequently, repetitive portrayal requires more bits to speak to a field component, where the quantity of portrayal bits relies upon the measure of the cyclostome field in which the hidden field is implanted. In the proposed augmentation, the summation of the rough logarithms decides the aftereffect of the task. Henceforth, the increases are rearranged to some move and include tasks. It depended on the decay of the information operands. This technique significantly enhanced the normal mistake at the cost of expanding the equipment of the inexact multiplier by around multiple times.

II. RELATED WORK

In this area, a portion of the past works in the field of estimated multipliers are quickly checked on. A rough multiplier and an estimated viper dependent on a method named broken-array multiplier (BAM) were proposed. By applying the BAM estimate strategy to the regular altered Booth multiplier, a surmised Signed Booth multiplier was displayed. The vast majority of the recently proposed estimated multipliers depend on either changing the structure or multifaceted nature decrease of an explicit exact multiplier. ROBA multiplier has the

accompanying points of interest 1) bring down power utilization by 6 requests of size 2) high recurrence activity (5– 10 GHz framework clock), 3) moderately basic rationale configuration approach.

Vitality minimization is one of the fundamental plan prerequisites in any electronic frameworks, particularly the convenient ones, for example, advanced mobile phones, tablets, and distinctive contraptions. It is exceedingly wanted to accomplish this minimization with negligible execution (speed) punishment. Computerized flag handling (DSP) squares are key parts of these convenient gadgets for acknowledging different sight and sound applications. The computational center of these squares is the number juggling rationale unit where duplications have the best offer among every single number-crunching activity performed in these DSP frameworks. In this manner, enhancing the speed and power/vitality effectiveness qualities of multipliers assumes a key job in enhancing the productivity of processors. Huge numbers of the DSP centers actualize picture and video handling calculations where last yields are either pictures or recordings arranged for human utilizations. This reality empowers us to utilize approximations for enhancing the speed/vitality productivity.

This begins from the constrained perceptual capacities of individuals in watching a picture or a video. Notwithstanding the picture and video preparing applications, there are other zone where the precision of the number juggling activities isn't basic to the usefulness of the framework. Having the capacity to utilize the estimated processing furnishes the creator with the capacity of making exchange offs between the exactness and the speed and in addition control/vitality utilization.

Applying the guess to the number juggling units can be performed at various plan reflection levels including circuit, rationale, and engineering levels, and also calculation and programming layers. The estimate might be performed utilizing distinctive procedures, for example, permitting some planning infringement (e.g., voltage over scaling or over timing) and capacity guess techniques (e.g., altering the Boolean capacity of a circuit) or a mix of them. In the class of capacity estimate techniques, various approximating number juggling building squares, for example, adders and multipliers, at various structure levels have been recommended. In this paper, we center around proposing a fast low power/vitality yet surmised multiplier suitable for blunder flexible DSP applications. The proposed augmentation approach is material to both marked and unsigned duplications for which three improved designs are displayed. The efficiencies of these structures are evaluated by looking at the deferrals, power and vitality utilizations, vitality postpone items (EDPs), and zones with those of some rough and precise (correct) multipliers. The fundamental plan of this paper is

- 1) Presenting another plan for RoBA augmentation by altering the traditional duplication approach;
- 2) Describing three equipment models of the proposed estimated augmentation conspire for sign and unsigned activities.

III. EXISTING MULTIPLIER

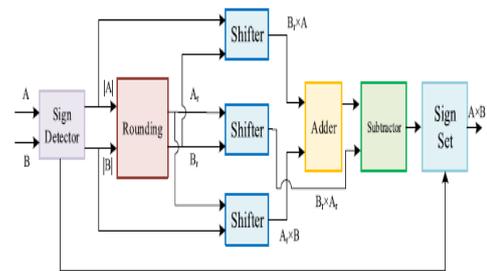


FIG.1. EXISTING MULTIPLIER

The above figure (1) shows the architecture of existed system. The devices used in this multiplier are sign detector, rounding, shifter, adder, subtract or and sign set. Where the inputs are represented in two's complement format. To begin with, the indications of the sources of input are resolved, and for each negative value, the total value is created. Coming to the rounding block, it takes the nearest value in the form of $2n$. It ought to be noticed that the bit width of the yield of this square is n (the most significant bit of the absolute value of the total estimation of a n -bit number in the two's supplement arrange is zero). In the existed system for every operation we use power n ($2n$). Here the inputs are denoted as Ar and Br . The multiplication process involved in this inputs can be written as shown below

$$A \times B = (Ar - A) \times (Br - B) + Ar \times B + Br \times A - Ar \times Br. \quad (1)$$

By using the shift operation the multiplications are implemented in this system. But the entire process is quite complex. The output can be measured from weight of the input terms. However, the entire multiplication operation can be performed based on the three shift and two addition/subtraction operations. After this operation, the nearest values of inputs A and B are determined. When the value of A (or B) is equal to the $3 \times 2^{p-2}$ then it is equal to absolute difference of 2^p and 2^{p-1} . But this value will not care in both rounding up and down process. So depend up on the magnitude of inputs the final result is calculated by RoBA multiplier.

Here if the input A is smaller than input B then result will be larger than the exact result. In the same way, if both inputs are smaller and both inputs are larger than the result will be smaller compared to output. Since Ar and Br are as $2n$, the contributions of the subtractor may take one of the three input designs. At long last, if the indication of the final multiplication result ought to be negative,

the yield of the subtractor will be discredited in the sign set square. To discredit esteems, which have the two ought supplement portrayal, the relating circuit dependent on $\bar{X} + 1$ to be utilized. To expand the speed of refutation task, one may skirt the implication procedure in the invalidating stage by tolerating its related blunder. As will be seen later, the criticalness of the blunder diminishes as the information widths increments.

In this, if the invalidation is performed precisely (roughly), the usage is called marked RoBA (S-RoBA) multiplier [approximate S-RoBA (AS-RoBA) multiplier]. For the situation where the sources of info are constantly positive, to expand the speed and lessen the power utilization, the sign identifier and sign set squares are excluded from the design, furnishing us with the engineering called unsigned RoBA (U-RoBA) multiplier. In this case, the output width of the rounding block is $n + 1$ where this bit is determined based on $Ar[n] = A[n - 1] \cdot A[n - 2]$. This is because in the case of unsigned $11x \dots x$ (where x denotes do not care) with the bit width of n , its rounding value is $10\dots0$ with the bit width of $n + 1$. Therefore, the input bit width of the shifters is $n + 1$. However, because the maximum amount of shifting is $n - 1$, $2n$ is considered for the output bit width of the shifters. To overcome the problem occurred in this system a new system is proposed which is discussed in below section.

IV. PROPOSED MULTIPLIER

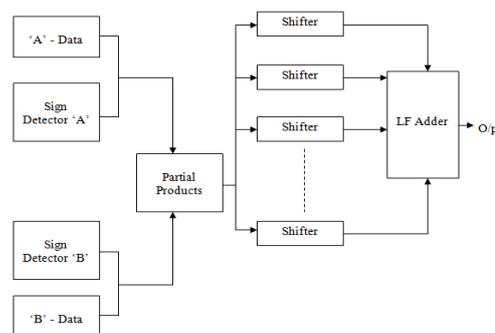


FIG. 2: PROPOSED MULTIPLIER

The above figure (2) shows the architecture of proposed multiplier. In this system the encrypted system we use LF adder, partial products, input vectors and shifters. In this paper, we have used input vectors to generate switching activities which can be used for energy estimation. This is an extra correct strength measuring technique and due to the fact that electricity consumption of a digital circuit is quite dependent on enter facts transitions and switching hobby of every internet in the circuit. For greater accurate energy estimation, full-timing in preference to zero-postpone gate stage simulation, with one thousand random vectors for inputs A and B, has been used for obtaining switching hobby information. In full timing simulation, system faults that affect the strength intake may be captured the power estimation glide.

Product generator is designed to produce the product by multiplying the multiplicand A by 0, 1, -1, 2 or -2. A 5 to 1 MUX is designed to determine which product is chosen depending on the M, 2M, 3M control signal which is generated from the MBE. The Ladner-Fischer Adder is flexible to speed up the binary addition and the structure looks like tree structure for the high performance of arithmetic operations. In Ripple Carry Adders each bit wait for the last bit operation. In Parallel Prefix Adders instead of waiting for the carry propagation of the first addition. The construction of Efficient Ladner-Fischer Adder consists of three stages.

They are Pre-Processing Stage, Carry Generation Stage, and Post-Processing Stage. The first inputs bits goes under Pre-Processing Stage and it will produce propagate and generate. These propagates and generates undergoes Carry Generation Stage produces carry generates and carry

propagates, these undergoes Post-Processing Stage and gives final sum. Basically, a multiplier is a combinational logic circuit used in digital systems to perform the multiplication of two binary numbers. Multiplier circuits are modelled after the “shift and add” algorithm. RoBA Multiplier has the advantage of reducing power consumption in the DSP systems. RoBA. Our proposed multiplier and the existing multipliers in comparison complete one discipline multiplication in one of a kind numbers of clock cycles. This proposed encrypted system will reduce the errors and produce effective results compared to existed system.

V. RESULTS

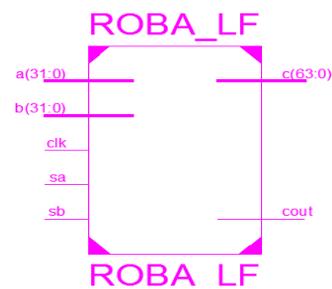


FIG. 3: RTL SCHEMATIC

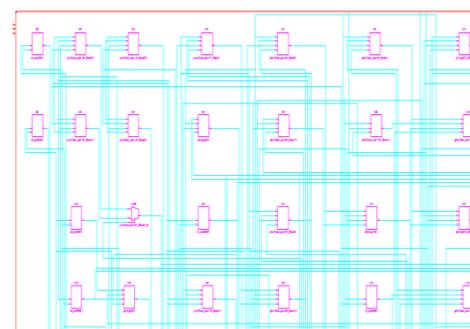


FIG. 4: TECHNOLOGY SCHEMATIC



FIG. 5: OUTPUT WAVEFORM

| LF Project Status (12/01/2018 - 22:13:16) | | | |
|---|----------------------|-----------------------|--------------------------|
| Project File: | ET09_xise | Parser Errors: | No Errors |
| Module Name: | ROBA_LF | Implementation State: | Synthesized |
| Target Device: | xc7z020-3svq200 | • Errors: | No Errors |
| Product Version: | ISE 14.7 | • Warnings: | 2135 Warnings (2135 new) |
| Design Goal: | Balanced | • Routing Results: | |
| Design Strategy: | Min Default (locked) | • Timing Constraints: | |
| Environment: | System Settings | • Final Timing Score: | |

| Device Utilization Summary (estimated values) | | | |
|---|------|-----------|-------------|
| Logic Utilization | Used | Available | Utilization |
| Number of Slices | 3813 | 960 | 398% |
| Number of FlipFlops | 3168 | 3920 | 80% |
| Number of bonded I/Os | 120 | 66 | 182% |

| Detailed Reports | | | | | |
|--------------------|---------|--------------------------|--------|--------------------------|-------|
| Report Name | Status | Generated | Errors | Warnings | Infos |
| Lintable Report | Current | Sat 1, Dec 22 13:13 2018 | 0 | 2135 Warnings (2135 new) | 0 |
| Translation Report | | | | | |
| Map Report | | | | | |

FIG. 6: REPORT

VI. CONCLUSION

In this paper we propose a rounding based approximate multiplier (ROBA). The approximate multiplier which is based on rounding is designed using Ladner Fischer adder which is more efficient than the previous approximate and accurate multipliers. An approximate multiplier (ROBA) using LF adder implementation was proposed in the paper. The Ladner Fischer adder is one of the parallel prefix adders which greatly reduce the consumption of area for higher order bits. The results show that the proposed multiplier shows better performance in terms of area, power and delay. The rounding based approximation resulted in reduced area when compare to other approximations. The efficiency of the proposed approximate multipliers were evaluated by comparing with some of previous approximate multipliers and the results reveals that proposed approximate multiplier is efficient in the applications where the area of the system is highly concerned.

VII. REFERENCES

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NARAYANAM ROJA NAGAJYOTHI completed B.Tech in Malineni Lakshmaiah engineering college, Singarayakonda, Prakasam(dt), Andhra Pradesh, India and Presently doing M.Tech in Malineni Perumallu Educational Society’s Group of Institutions, Guntur, Andhra Pradesh, India. Her specialization is VLSI.



A.ANCIA completed B.E in Saranathan College of engineering, Trichy, Tamilnadu, India And M.E in Alagappa Chettiar College of Engineering and Technology, Karaikudi, Tamilnadu, India. Presently working as Assistant Professor in Malineni Perumallu Educational Society’s Group of Institutions, Guntur, Andhra Pradesh, India