A NOVEL APPROACH TO SQUARING TECHNIQUE USING VEDIC MATHEMATICS APPLIED WITH EDSIM51 SOFTWARE

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Abstract

In this era of '*speed'* everyone not only desires the fast track but also strives very hard to achieve it. Speed is only enjoyed to the fullest when it reaches the aspirant, blended with accuracy. Both speed and accuracy can be experienced using the age-old Indian approach to mathematics, Vedic mathematics. This paper briefly emphasizes about Vedic mathematics and a sutra which helps in finding squares faster than present day conventional methods. Comparison between the Vedic algorithm and conventional algorithms has been done with the help of EdSIM51 software. The Vedic algorithm, *Yavadadikam Tavadhadhikeekrutya Vargamcha Yojayeth* (YTVY), has exhibited remarkable results with respect to conventional squaring algorithms in terms of quicker squaring, thereby once again proving the famous proverb that *Old is Gold*. The conclusion of this paper is that the Vedic squaring method is much more efficient than that of regular squaring in terms of execution time.

Keywords: Vedic Mathematics, Faster squaring, Yavadhadikam Tavadhadhikeekrutya Vargamcha Yojayeth.

Introduction

Vedic mathematics is the name given to the ancient approach to mathematics in India. It was rediscovered in the early 20th century by Sri Bharathi Krishna Teerthaji [1] from ancient Vedas (Indian scriptures) after his eight years of research on Atharva Veda. Thus the name 'Vedic mathematics' has been given. The Sanskrit word Veda is derived from the root word Vid, meaning to know without limit. The word Veda covers all Veda-sakhas known to humanity. The Veda is a repository of all knowledge, fathomless, ever revealing as it is delved deeper.

Vedic mathematics mainly comprises of 16 main sutras (aphorisms) and 13 sub sutras (corollaries). With these formulae we get to optimise present day mathematical calculations, increase speed and reduce complexity. These methods and ideas can be directly applied to trigonometry, plain and spherical geometry, conics, calculus (both differential and integral), and applied mathematics of various kinds. The main purpose of Vedic maths is to reduce labour in solving complex math calculations. This paper briefly describes the sutras Yaavadadhikam Tavadhadhikeekrutya Vargamcha Yojayet.

The rest of the paper is organized as follows. Section II gives detailed discussion of Vedic algorithm (YTVY) with an algebraic proof together with a comparison between Vedic and conventional approaches. Section III summarizes the performance evaluation and result analysis. Section IV gives a summary conclusion.

I. Yavadadhikam Tavadadhikeekrutya Vargamcha Yojayet

The meaning of this Vedic sutra is "Whatever the surplus add that surplus to the number and write alongside the square of the surplus". This Sutra can be applicable to obtain squares of numbers close to bases of powers of 10.

Mathematically it can be written as:

$$(X+Y)^2 \textit{ or } (A)^2 = X^2+2*X*Y+Y^2 \text{ --- (1)}$$
$$= X(X+2*Y)+Y^2$$
$$= X(X+Y+Y)+Y^2$$
$$= X(A+Y)+Y^2 \text{ --- (2)}$$

$A = X + Y$ (A = given number)

X = Base number ; Y = Surplus

1 is the conventional formula; 2 is the Vedic formula

From the above expressions (1&2) we can observe that the Vedic formula has reduced the number of multiplications and additions when compared to the regular conventional squaring formula. Which suggests that faster calculations are possible with a Vedic formula.

Algorithm

1. Separate the given number [A] into two numbers, surplus [Y] (units digit) and other number be base of the number [X] (given number minus units place integer)
2. Add surplus [Y] to the actual number [A] , i.e. [A+Y]
3. Square the surplus value, i.e. [$Z_1 = Y^2$]
4. Multiply the sum of actual number and surplus with the base number, i.e. [$Z_2 = (A+Y)*X$]
5. Add square of units digit and above product, i.e. [$Z = Z_1+Z_2$]
6. It is the square of the given number, i.e. [$A^2 = Z = ((A+Y)*X)+Y^2$]

Programmes

Vedic math implementation program

- mov a,#00h
- mov r0,a
- mov b,#10
- div ab
- mov r2,a
- mov a,r0
- add a,b
- mov r0,a
- mov a,b
- mul ab
- mov a,#00h
- mov r0,a
- mov b,#10
- div ab
- mov r2,a
- mov a,r0
- add a,b
- mov r0,a
- mov a,b

Conventional math implementation program

- mov a,#00h
- mov b,#10
- div ab
- mov r0,a
- mov r1,b
- mul ab
- mov b,#20
- mul ab
- mov 31h,a
- mov 30h,b
- mov a,r1
- mov b,a
- mul ab
- mov 32h,a
- mov a,r0
- mov b,a
- mul ab
- mov 33h,b
- mov b,#64h
- mul ab
- add a,31h
- jc here
- loop:add a,32h
- jc h2
- l2:mov 37h,a
- mov 36h,b
- mov a,33h
- mov b,#64h
- mul ab
- add a,30h
- add a,34h
- add a,36h
- mov 36h,a
- back: sjmp back
- here: inc b
- sjmp loop
- h2: inc b
- sjmp l2

Limitations

Implementing YTVY alone might become tiresome when the given number is more than 4 digits$_{10}$ (in decimal numbering system). However, YTVY combined with another two sutras of Vedic maths viz, Vyashtisamasti and Vilokanam can overcome this hurdle.

Example 1 145^2

Vedic method

$(145)^2 = (145+5)*140+5^2$
$= (150)*140+5^2$
$= 21000+5^2$
$= 21000+25$
$= 21025$

Conventional method

$(145)^2 = 140^2+5^2+2*140*5$
$= 19600+5^2+2*140*5$
$= 19600+25+2*140*5$
$= 19600+25+280*5$
$= 19600+25+1400$
$= 19625+1400$
$= 21025$

or

$=100^2+45^2+2*100*45$
$=10000+45^2+2*100*45$
$=10000+2025+2*100*45$
$=10000+2025+200*45$
$=10000+2025+9000$
$=12025+9000$
$=21025$

Example 2 89^2

Vedic method

$(89)^2 = (89 + 9)*80 +9^2$
$= 98*80+9^2$
$= 7840+9^2$
$= 7840+81$
$= 7921$

Conventional method

$(89)^2 = 80^2 + 9^2 + 2*80*9$
$= 6400 + 9^2 + 2*80*9$
$= 6400 + 81 + 2*80*9$
$= 6400 + 81 + 160*9$
$= 6400 + 81 + 1440$
$= 7921$

or

$= 89*89$
$= (89*9) + (89*80)$
$= (80*9+9*9) + (80*80+80*9)$
$= (720+9*9) + (80*80+80*9)$
$= (720+81) + (80*80+80*9)$
$= 801 + (80*80+80*9)$
$=801 + (6400+80*9)$
$=801 + (6400+720)$
$=801 + (7120)$
$=7921$

III. Results and Discussions

For performance analysis an 8-bit Microcontroller, 8051 MC, has been used @12MHz. At each execution the time taken has been noted down, to tabulate and compare maximum, minimum and average times taken up by Vedic and conventional algorithms. The following pictures show the screenshots taken while testing out both the algorithms. Whereas Fig.1 shows the implementation of Vedic algorithm, Fig.2 shows implementation of a conventional algorithm in finding $\{145^2\}_{10}$ or $\{91^2\}_{16}$ as taken from Example 1. Table 1 gives the comparison of the Vedic algorithm and conventional algorithm based on the time consumed and number of instructions taken for arriving at the answer.

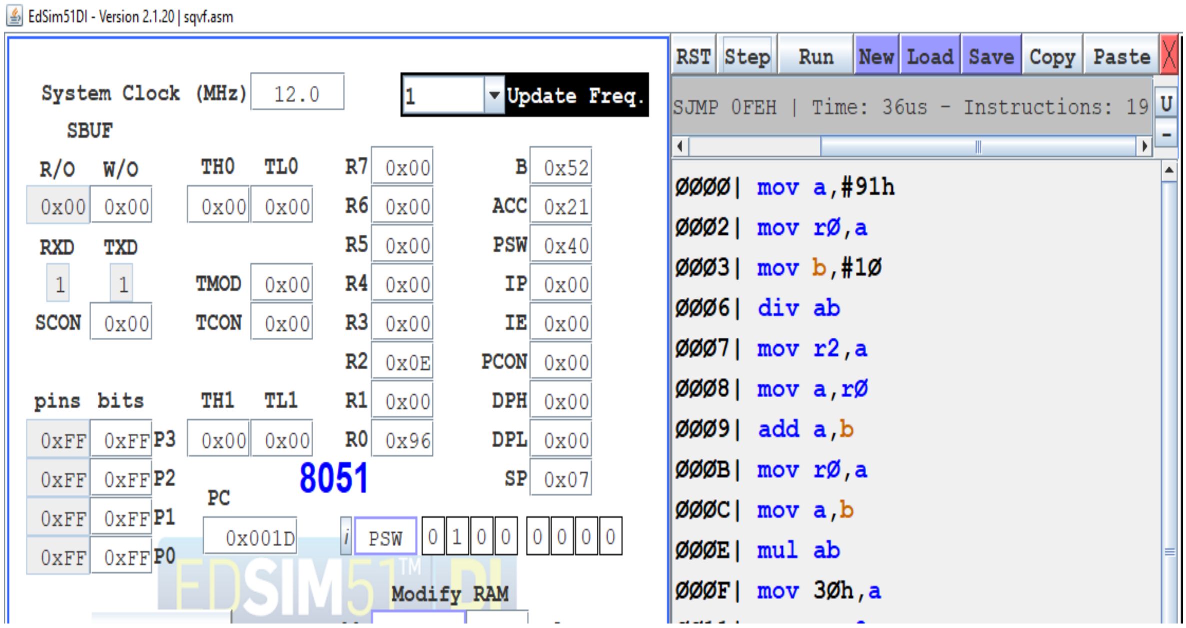

Fig.1 Vedic algorithm implementation

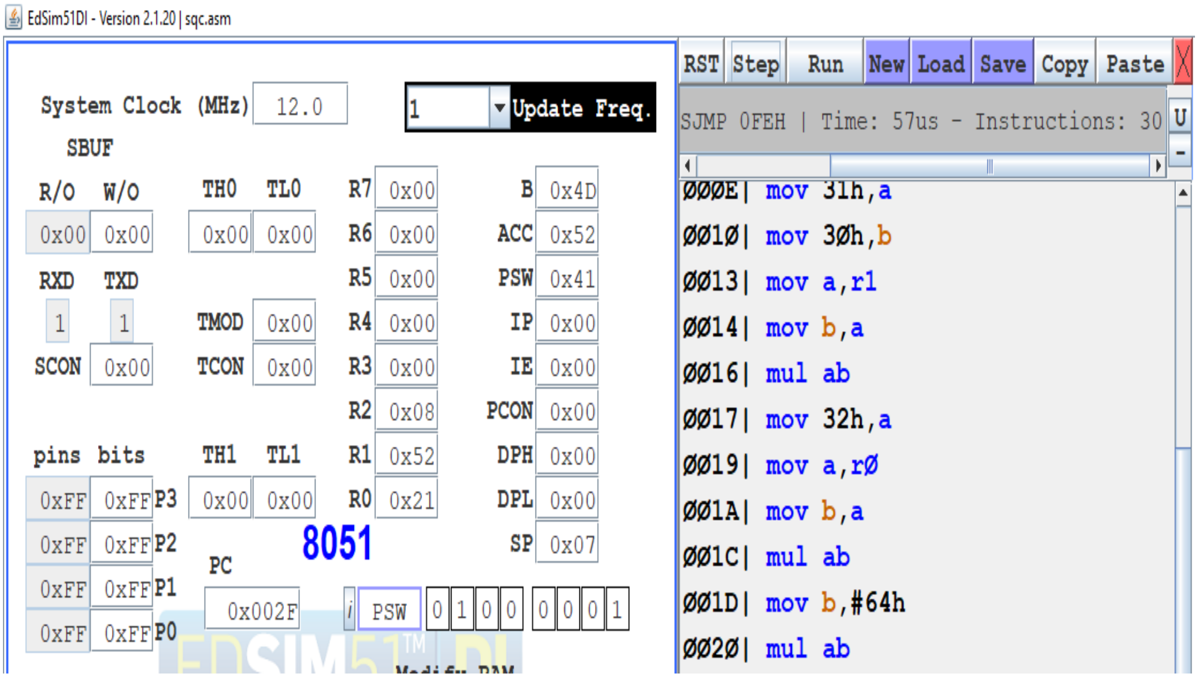

Fig.2 Conventional algorithm implementation

Table.1 Comparison

	Conventional method	Vedic method
Maximum time taken (in µs)	69	41
Minimum time taken (in µs)	66	36
Average time taken (in µs)	67.8	37
Maximum number of iterations	36	22
Minimum number of iterations	34	19

IV. Conclusion

Remarkable results have been achieved with Vedic algorithm, *Yavadunam Tavadoonikrutya Vargamcha Yojayet* compared to conventional squaring algorithms in terms of quicker squaring. The inclusion of Vedic mathematics in school syllabuess, not only helps students learn mathematics faster and perform better but also for building all hardware and software based on ancient Indian approach (Vedic approach)

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