JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A REVIEWED STUDY ON DESIGN OF COMPARATOR MODULE IN CARBON NANO TUBES

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ABSTRACT

Carbon nanotube field effect transistor (CNTFET) demonstrates extraordinary guarantees as extension to Silicon MOSFET for building superior and low power VLSI circuit. Three-esteemed (ternary) rationale is a promising contrasting option to conventional binary rationale for achieving straightforwardness and vitality effectiveness in present day advanced design. Ternary rationale has an exquisite relationship with CNTFET on the grounds that the most ideal approach to design ternary circuit is the multiple threshold strategy and wanted edge voltage can be effortlessly accomplished by using unique diameter of CNT in CNTFET gadget.

This postulation creates designs of ternary math and rationale unit (TALU) and substance addressable memory cell utilizing CNTFETs. Initial, 2-bit hardware advanced ternary ALU (HO-TALU) is introduced. 2-bit HO-TALU gets minimization in required hardware at both design and additionally at circuit level. At engineering level, HO-TALU has another adder sub tractor (AS) module which performs both expansion and subtraction operations utilizing an snake module just with the assistance of multiplexers. Along these lines, it disposes of a sub tractor module from the regular engineering. At circuit level, HO-TALU limits ternary capacity articulations and uses binary gates alongside ternary entryways in acknowledgment of useful modules: AS, multiplier, comparator and select OR.

INTRODUCTION

Design of a 2-bit hardware optimized ternary ALU (HO-TALU) has been displayed utilizing CNTFETs. This part introduces performance helped designs of sub-squares of CNTFET-based 2-bit HO-TALU utilizing diverse circuit systems. Three new designs of ternary full viper (TFA) which is an essential sub-square of snake subtract

or (AS) are proposed. These designs are optimized as far as speed, power lastly power-delay product (PDP). The main TFA design named as rapid TFA (HS-TFA) utilizes a symmetric pull-up and pull-down networks alongside a resistive voltage divider as its fundamental part, which is configured utilizing transistors. Contrasted with as of late created TFA accessible in literature, HS-TFA gets enhanced speed yet high power dissipation. Keeping in mind the end goal to lessen power consumption, a moment TFA named as low power TFA (LP-TFA) is proposed. LPTFA makes utilization of complimentary pass transistor rationale style and accomplishes low power consumption with marginal lessening in PDP. To get enhanced PDP further, a third TFA is actualized in unique rationale. This TFA is named as unique TFA (DTFA) which utilizes a manager designed for ternary esteems to reduce charge sharing issue. The realization of each of the three TFA takes the benefits of innate binary nature (0 and 1) of information convey prompting straightforwardness in designs.

Further, downsizing the entryway length of CMOS innovation in nano ranges brings about different basic difficulties and unwavering quality issues. One of the issues is expanded leakage current which happens because of different quantum mechanical tunneling including band-to-band tunneling, coordinate gate oxide tunneling, and source to deplete tunneling. Different issues are vast process varieties, the effects of gem mis arrangements, the arbitrariness of discrete doping, and addition of interface scatterings since the mean free way of electrons ends up plainly equivalent to part measurements. These gadget level effects cause the current-voltage (I-V) qualities to be generously unique in relation to very much tempered MOSFET. Subsequently, analysts have significant concerns in regards to additionally enhancing gadget execution by downsizing the component size of MOSFET. Plus, circuit level effects for example, short channel effects, augment in the resistance of metallic on-chip interconnects furthermore, control dissipation will clearly lessen the appropriateness of MOSFET for cutting edge applications so as to come.

Scientists grew twofold entryway MOSFETs and FinFET/tri-gate gadgets to decrease short channel effects. In these gadgets, entryway is put on two/three sides of the channel, which brings about better control on the direct and significant diminishment in deplete to source sub-edge leakage current.

The main CNT-based transistor is declared. From that point onward, noteworthy advancements were accomplished in the fabrication of CNT-based gadgets furthermore, circuits. In view of CNTFETs, some cutting edge designs, for example, rationale entryways, five stage ring oscillator manufactured along a solitary CNT, a capacitive sensor interface circuit, a permeation transport-based decoder, remain solitary circuit components, for example, half-snake whole generators, D-locks and static random get to memory (SRAM) cells have been manufactured. In 2006, IBM exhibited the main IC constructed

utilizing SWCNTs. Cao et al. declared that they made medium scale IC utilizing CNTFETs on a thin plastic substrate. Like the first silicon based PC, the CNT PC is a synchronous advanced framework which runs put away projects and is programmable. The working arrangement of this PC accomplishes multitasking by executing an including program and a whole number arranging program simultaneously. In spite of the fact that the working recurrence of the CNT PC is accounted for to be 1 KHz just because of scholarly trial constraints and capacitive stacking presented by the estimation setup, this showing is an imperative turning point in the improvement of complex and exceptionally vitality productive CNT based electronic framework. At display, the major difficulties confronted by CNT innovation are the CNT misalignment and undesirable development of metallic tubes.

A TFA includes three bits (A, B and C_{in}) in which A and B are critical bits (1-bit ternary numbers) and C_{in} is convey bit produced by the past piece expansion amid N-bit operation. In this, the greatest aggregate of A and B is 4 in any event noteworthy position and 5 at other positions, which gives most extreme estimation of C_{in} i.e. rationale 1. In this manner, C_{in} never gets rationale 2 in N-bit ternary expansion. By utilizing this idea, TFA is designed in light of the binary nature (0 also, 1) of Cin with ternary nature of A and B.

The stick chart and piece outline of the primary proposed TFA named as HS-TFA are appeared in Figure 4.1. Reality table of TFA is given in Table 4.1, where Aand B are ternary in nature, and C_{in} is binary in nature (0 and 1). HS-TFA has three information sources A, B and C_{in}, and two outputs Sum and Carry. Sources of info A, B and C_{in} are gone through 1-to-6-line ternary decoders DEC1, DEC2 and DEC3, separately, to create their unary capacities. HS-TFA comprises of a Sum generator and a Carry generator to deliver Sum and Carry signals. Entirety generator contains symmetrical pull-up organize (PUN) and pull-down system (PDN) alongside resistive voltage divider which is actualized utilizing two always exchanged ON transistors T1 and T2. A square set apart as 'Joke for Σin =1, 2, 4 and 5' speaks to a system that will exchanged ON when $\sum (A+B+C_{in}) = 1, 2, 4$ and 5. Thus, a square set apart as 'PDN for Σin =0, 1, 3 and 4' speaks to a system that will exchanged ON when $\sum (A+B+C_{in}) = 0, 1, 3$ and 4. These squares are designed in light of their changing exercises required to create Aggregate. The nitty gritty schematic of Sum generator is appeared in Figure 4.3 (a). Further, T1 (PCNTFET) furthermore, T2 (N-CNTFET) having same geometry achieve a similar resistance and perform voltage division to get rationale 1 for Sum. Table 4.2 abridges how the ON condition of relating PUN and PDN associate Sum to suitable voltage source (Vdd or ground) for every conceivable blend of A, B and C_{in}. Whenever $\sum (A+B+C_{in}) = 0$, PDN is turned ON which interfaces Sum to ground through T2. In spite of the fact that T1 is additionally ON, the PUN is OFF. At the point when $\sum(A+B+C_{in}) = 1$, both PUN and PDN are accordingly ON, nodes X2 and X1 are charged to Vdd and 0, individually, and T1 and T2 perform voltage division between node voltages of X1 and X2, and create Sum as

(X1+X2)/2 = Vdd/2 (i.e. voltage level of rationale 1).

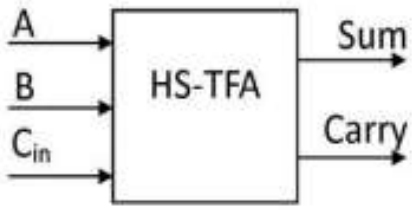

Figure 1. (a): Pin diagram of high speed ternary full adder (HS-TFA)

LITERATURE REVIEW

The capability of CNTFET for superior and low power current designs due to its different excellent properties, for example,

Novel 1-D band structure, ballistic transport operation also, low OFF-current, has been illustrated.

Sipos et al. depicted a design technique for ternary multiplexers with any number of data sources. They utilized 3-to-1-line ternary multiplexer as an essential circuit to design those multiplexers having higher number of information sources. This fundamental multiplexer was constructed utilizing least and most extreme ternary capacities, and the control circuit was constructing utilizing ternary circuits named as pointers of rationale levels. Designs of multiplexer were actualized utilizing supplementary symmetrical rationale circuit (SUS-LOC) structure, and recreated in ORCAD condition utilizing transistors from Breakout library to approve their operation.

Sathish et al. exhibited a technique for characterizing, implementing, analyzing, testing ternary circuits with VHDL Simulator. They exhibited VHDL displaying of ternary circuits, for example, 9-to-1-line and 27-to-1-line multiplexers, half snake, half subs tractor, full viper, full subs tractor, 1- bit multiplier, 1-bit and 2-bit comparator, swell convey snake and convey spare viper, 1-bit and 2-bit position shifter and barrel shifter, where all circuits were actualized utilizing 3-to-1-line multiplexers. Every one of the designs were recreated utilizing VHDL test system with the assistance of innovation subordinate bundle called 9-state StdLogic_1164 bundle to check their usefulness and timing determinations.

Gundersen et al. conveys free adjusted ternary snake (BTA) actualized utilizing revived CMOS semi skimming entryway (RSFG) devices. They additionally understood an adjusted ternary subs tractor by applying transformed contributions to BTA. This snake contains RSFG ternary inverter squares, auto zero circuit which change over an info flag to a legitimate energize flag, and metal plate capacitors. BTA offers convey free expansion and hence, can be used as a

fundamental piece in figuring it out quick multiplier circuits. Creators likewise depicted a design of ternary counter in light of RSFG devices. This counter uses adjusted ternary documentation and reasonable for usage of quick viper structure which can include both positive and negative operands. They likewise introduced a comparator structure in view of RSFG ternary inverter pieces and metal plate capacitors. RSFG based designs were reenacted by utilizing Cadence with simple design condition in 90 µm CMOS process. These circuits work at a clock frequency of 1 GHz with power supply voltage of 1.0 V as it were.

Wang et al. presented the guideline of vitality recuperation and switch level design system for the design of ternary circuits. They exhibited a design of 4 x 4 ternary adiabatic multiplier. In this design, twofold power clocks were utilized for charging and releasing of the yield node capacitances in adiabatic way through bootstrapped NMOS transistors and cross-memory structure. This design was recreated in PSPICE with TSMC 0.25 µm CMOS gadget. The announced outcomes demonstrated that it devours 91% less vitality as for that of twofold pass transistor rationale based ternary multiplier.

High Speed TFA (HS-TFA)

The stick chart and piece outline of the primary proposed TFA named as HS-TFA are appeared. Reality table of TFA is given in Table 4.1, where Aand B are ternary in nature, and C_{in} is binary in nature (0 and 1). HS-TFA has three information sources A, B and C_{in}, and two outputs Sum and Carry. Sources of info A, B and C_{in} are gone through 1-to-6-line ternary decoders DEC1, DEC2 and DEC3, separately, to create their unary capacities. HS-TFA comprises of a Sum generator and a Carry generator to deliver Sum and Carry signals. Entirety generator contains symmetrical pull-up organize (PUN) and pull-down system (PDN) alongside resistive voltage divider which is actualized utilizing two always exchanged ON transistors T1 and T2. A square set apart as 'Joke for Σin =1, 2, 4 and 5' speaks to a system that will exchanged ON when $\sum (A+B+C_{in}) = 1, 2, 4$ and 5. Thus, a square set apart as 'PDN for Σin =0, 1, 3 and 4' speaks to a system that will exchanged ON when $\sum (A+B+C_{in}) = 0, 1, 3$ and 4. These squares are designed in light of their changing exercises required to create Aggregate. The nitty gritty schematic of Sum generator is appeared in Figure 4.3 (a). Further, T1 (PCNTFET) furthermore, T2 (N-CNTFET) having same geometry achieve a similar resistance and perform voltage division to get rationale 1 for Sum. Table 4.2 abridges how the ON condition of relating PUN and PDN associate Sum to suitable voltage source (Vdd or ground) for every conceivable blend of A, B and C_{in}. Whenever $\sum (A+B+C_{in}) = 0$, PDN is turned ON which interfaces Sum to ground through T2. In spite of the fact that T1 is additionally ON, the PUN is OFF. At the point when $\sum(A+B+C_{in}) = 1$, both PUN and PDN are accordingly ON, nodes X2 and X1 are charged to Vdd and 0, individually, and T1 and T2 perform voltage division between node voltages of X1 and X2, and create Sum as (X1+X2)/2 = Vdd/2 (i.e. voltage level of rationale 1). Whenever $\sum (A+B+C_{in}) = 2$, PUN is

exchanged ON and associates Sum to Vdd through T1. Also, for different estimations of ∑ ($A+B+C_{in}$), Sum gets the best possible incentive through PUN, PDN or both, as appeared.

Design of Comparator Module

Regular designs of ternary comparator exhibited in, create three essential outputs: GR, LE and EQ that indicate A > B, A < B and A = B conditions, individually. At the point when A > B, outputs GR, LE and EQ moves toward becoming 2, 0 and 0, individually. For A < B, outputs GR, LE and EQ are 0, 2 and 0, correspondingly. Essentially, when A = B, outputs GR, LE and EQ moves toward becoming 0, 0 and 2, individually. It is watched that lone two outputs are adequate to translate the magnitude relationship amongst An and B, as appeared in Table 4.5. Consequently, just two outputs GR and EQ are considered for the reaction of proposed comparator. Be that as it may, it makes the disentangling rationale of comparator reaction complex in those applications where three outputs are coveted.

CONCLUSION

In this part, design of 2-bit HO-TALU utilizing CNTFETs has been exhibited. 2-bit HOTALU has another AS module which performs both expansion and subtraction operations utilizing a viper module just with the assistance of MUXs. In this manner, it dispenses with a subtractor module from the customary architecture. HO-TALU limits ternary capacity articulations and uses binary entryways alongside ternary doors in realization of practical modules: AS, multiplier, comparator and exclusive-OR. As a result, the sub-pieces of AS: HAS and FAS utilize about 76% and 82% less transistors, separately, than regular designs which contain isolate viper and subtractor squares. Multiplier, comparator and exclusive-OR show lessening in gadget number by 64%, 82% and 76%, individually, regarding their current counterparts. Results got from HSPICE test system with Stanford model of 32nm CNTFET have appeared that all HO-TALU modules accomplish extraordinary improvement (about two hundred times) in PDP with regard to their CMOS-based partner, which checks the potential advantage of CNTFET circuits. In examination with existing CNTFET-based designs, proposed multiplier, comparator what's more, exclusive-OR get decrease in PDP by 75%, 65% and 28%, separately. Be that as it may, PDP of sub modules HAS and FAS has marginally expanded by 2% and 5%, individually. Accordingly, all HOTALU modules accomplish great hardware productivity with a minor loss of PDP for expansion and subtraction operations just, regarding CNTFET circuits accessible in the literature. Additionally, design of 2-bit HO-TALU is stretched out to build up a 2-bit HO-TALU cut which could be effortlessly fell to build a N-bit HO-TALU.

Design of proposed 2-bit HO-TALU is broke down and assessed utilizing Synopsys HSPICE test system with the Stanford model of 32 nm CNTFET which incorporates non-idealities of CNTFET. Points of interest of the Stanford

display have been shown in area 2.2 of section 2. The chirality vector of CNTFETs utilized as a part of binary gate and TG square is (19, 0). The edge voltage of these transistors is 0.289V with the diameter of 1.487 nm. The diameter of CNTFETs used in ternary gate is given in area of this part. Other innovation parameters of CNTFET have same esteems as said in segment.

To perform correlation of proposed ternary designs in CNTFET innovation, TALU design introduced in is recreated. For this, circuits of TALU modules displayed are taken also, executed utilizing CNTFET-based ternary gate as these rationale entryways beat other existing CNTFET-based entryways. Design of THA exhibited prompts vitality productive also, smaller design as for other CNTFET-based THA circuits. As a result, THS, TFA and TFS are likewise actualized utilizing the design approach of and alluded as CNTFET-based circuits of, for examination of HAS and FAS. Further, keeping in mind the end goal to perform examination with 32 nm CMOS innovation, proposed circuits are executed utilizing CMOS based binary and ternary rationale gate introduced. The CMOS-based ternary gate utilizes numerous voltages for limit voltage change and depends on multi-edge strategy for ternary operation. Berkeley Predictive 32nm CMOS demonstrate is utilized to reenact CMOS based designs. For duplicated designs, viewpoint proportions of MOSFETs, diameter of CNTFETs and estimation of different parameters, are picked by the data given in the particular papers from the literature.

REFERENCES

1. D. H. Roberts, “Silicon integrated circuits: A personal view of the first 25 years,” Electronics and Power, vol. 30, no. 4, pp. 282-284, Apr. 1984.
2. J.S. Kilby, “The Integrated Circuit's Early History,”in Proc. IEEE, Jan. 2000, vol. 88, no. 1, pp. 109-111.
3. N. Srivastava and K. Banerjee, “Performance Analysis of CarbonNanotube Interconnects for VLSI Applications,”in Proc. IEEE/ACM Int. Conf. ComputerAided Design, Nov.2005, pp. 383-390.
4. Reddy, R. Gopi Reddy1 M. Sanjeeva."Design and Implementa-tion of SOC Bus Based on AMBA 4.0."
5. S. C. Kang and Y. Leblebici, “Introduction,” in CMOS digital integrated circuits:analysis and design, Tata McGraw-Hill Edition: New Delhi, 2003, pp. 1-45.
6. E. Mollick, “Establishing Moore’s Law,” in IEEE Annals History Computing, JulySept. 2006, vol. 28,no. 3, pp. 62-75.
7. M. Horowitz, E. Alon, D. Patil, S. Naffziger, R. Kumar and K.Bernstein, “Scaling, Power, and the Future of CMOS,” in Proc. IEEE Int. Electron Device Meeting, IEDM Tech. Dig.,Washington, DC, Dec. 2005, pp.
8. Manishaben Jaiswal,Mehul patel, "AUTOMATION WITH NETWORKING AND ARTIFICIAL INTELLIGENCE", International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882,

Volume.9, Issue 1, pp.4748-4759, January 2021, Available at :http://www.ijcrt.org/papers/IJCRT2101582.pdf

9. 7-15. 7. F. Schwierz, J. Pezoldta and R. Granznera, "Two-dimensional materials and their prospects in transistor electronics," Nanoscale, vol. 7, no. 18, pp. 8261-8283, Apr. 2015.

10. The International Technology Roadmap for Semiconductors, 2013 ITRS edition. Available: http://www.itrs.net.

11. K. Roy, S. Mukhopadhyay and H. Meimand-Mehmoodi, "Leakage current mechanisms and leakage reduction techniques in deep-submicron CMOS circuits," in Proc. IEEE, Feb. 2003, vol. 91, no. 2, pp. 305-327.

12. C. Durkan, "Current at the nanoscale - an introduction to nanoelectronics," Imperial College Press, Cambridge: UK. (Book cover all effects), Mar. 2007.

13. K. Saraswat, H. Cho, P. Kapur and K-H. Koo, "Performance Comparison between Copper, Carbon Nanotube and Optical Interconnects," in Proc.IEEE Int. Symp. Circuits and Systems, Seattle, WA, May 2008, pp. 2781-2784. P. Avouris, M. Radoslavjevic and S. Wind, "Carbon nanotube electronics and Optoelectronics, in Carbon Nanotubes,"Springer-Verlag, Berlin, Germany, 2004.

14. D. Hisamoto, L. Wen-Chin, J. Kedzierski, E. Anderson, H.Takeuchi, K.Asano, K. Tsu-Jae, J. Bokor and H. Chenming, "A folded-channel MOSFET for deep-sub-tenth micron era," in Proc. IEEE Int. Electron Device Meeting, IEDM Tech. Dig.,San Francisco, CA, USA, Dec. 1998, pp. 1032-1034.

15. J. Kavalieros, B. Doyle, S.Datta, G. Dewey,M. Doczy, B.Jin, D.Lionberger, M.Metz, W.Rachmady, M. Radosavljevic, U.Shah, N. Zelick and R.Chau, "Tri-Gate Transistor Architecture with High-k Gate Dielectrics, Metal Gates and Strain Engineering," in Proc. IEEE Int. Symp. VLSI Technol., Honolulu, HI, 2006, pp. 50- 51.

16. Emerging Research Devices, in International Technology Roadmap for Semiconductors, 2009 ITRS edition. Available: http://www.itrs.net.

17. Y. Cui, Z. Zhong, D. Wang, W. U. Wang, and C. M. Lieber, "High Performance Silicon Nanowire Field Effect Transistors," Nano Lett., vol. 3, no. 2, pp. 149-152, 2003.

18. T. Ashley, A.R.Barnes, L. Buckle, S. Datta, A.B. Dean,M.T. Emery,M.Fearn, D.G. Hayes,K.P. Hilton,R. Jefferies, T.Martin, K.J. Nash,T.J. Phillips,W.A Tang,P.J. Wilding and R.Chau, "Novel InSb-based quantum well transistors for ultra-high speed, low power logic applications," in Proc. IEEE 7thInt. Solid-State and Integrated Circuits Technology, Oct. 2004, vol. 3, pp. 2253-2256.