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Research Paper

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Lockless Multi Stable Analog Circuit Using CNTFETs

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ABSTRACT: This paper presents the implementation of multistable analog circuits using CNTFETs technology .In modern era as scaling of technology is done to deal with several factors like Power dissipation, delays, reduction of leakage currents etc. CMOS may not provide such a huge amount of flexibility as required in modern processing therefore CMOS transistors must be replaced by some more sophisticated technology like carbon nanotubes. Due to various advantages over CMOS technology like high stability, enhanced performance CNTFETs can be used for implementation of multistable analog circuits. LIQAF technique is used to increase the stability level of these circuits.

KEYWORDS: Carbon Nanotube Field Effect Transistors (CNTFETs), nano technology, multi stable, LIQAF.

I. INTRODUCTION

CNTFETs (Carbon Nanotube Field Effect Transistors) are novel devices that are expected to sustain the transistor scalability while increasing its performance. One of the major differences between CNTFETs and MOSFETs is that the channel of the devices is formed by Carbon NanoTubes (CNTs) instead of silicon, which enables a higher drive current density, due to the larger current carrier mobility in CNTs compared to bulk silicon [1]. In particular, with CNTs we obtain good operation even at very high frequencies [2-8]. A number of different geometries and solutions for CNTFETs, as well as their DC and low frequency behaviour [9-11], have been evaluated and reported in many papers.When silicon doped well of CMOS (complementary metal oxide semiconductors) transistors are replaced by carbon nanotube material, a huge amount of complexities can be easily overcome, this will further provide a way to put several transistors on single ICs. As CNTs is the answer to various scaling problems like crosstalk, power dissipation etc. thus, if a CMOS MULTISTABLE ANALOG CIRCUIT is implemented through CNTs (carbon nano tubes) it will provide a huge advantage over power dissipation factor. The modified circuit consists of a multi stable analog circuit with CNTFETs (carbon nano tubes field effect transistors) as its basic transistors. Following CNTFET based multi stable circuit is explained with its DC response and power dissipation output showing its utilization for future aspects.

II. BASIC CMOS MULTISTABLE ANALOG CIRCUIT

The theory and experiments have demonstrated that a single walled carbon nanotube (SWCNT) can be either metallic or semiconducting, depending upon the arrangement of carbon atoms. The

conventional CMOS multistable analog circuit is implemented in fig.1. These circuits are stable in various states. To switch them from one state to another an external pulse is required. In these circuits multiple stability points can be achieved with increasing number of transistors in various stages.

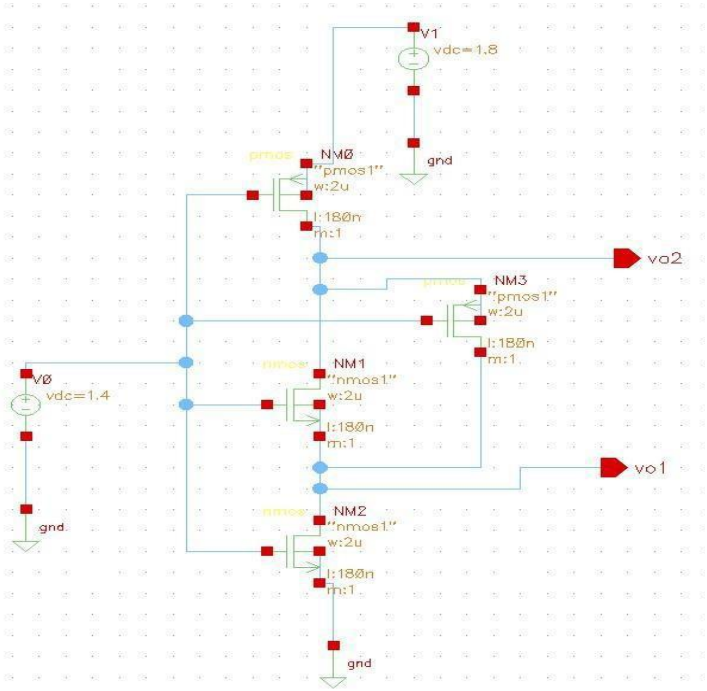

Fig1. Conventional CMOS multi stable analog circuit

III. CMOS multi stable analog circuit using (LIQAF)

LIQAF (laddered inverter\Quantizer\Amplifier\Filter) circuit is used to obtain multiple stability points. LIQAF provides non-linear feedback to attain multiple stable points. Fig.2 shows CMOS multi stable analog circuit with LIQF.

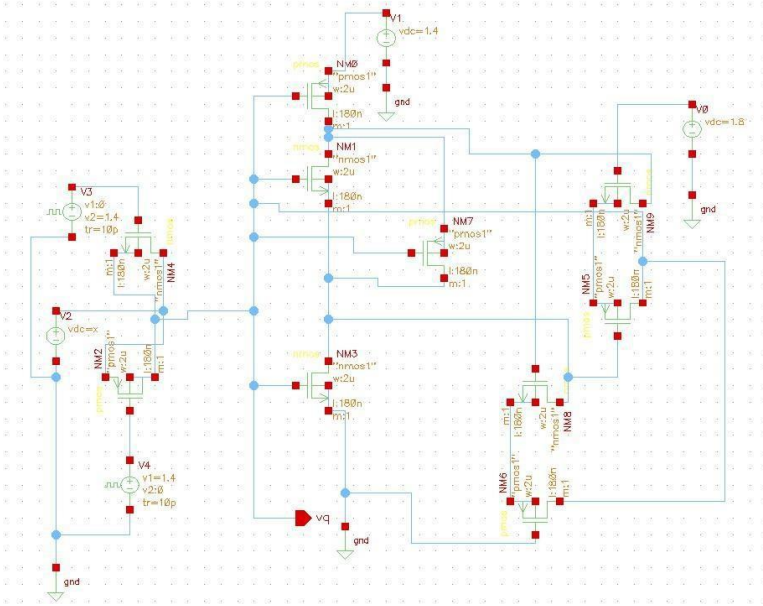

Fig 2. CMOS multi stable analog circuit using LIQAF feedback

IV. Modified Circuit using CNTFETs.

CNTFETs are much more effective and efficient in comparison to CMOS based circuits. Fig.3 shows modified analog circuit using CNFET. To understand this, a comparison table of 32nm technology parameter of both is given below in table.1.

Parameter	CNTFETs	CMOS
Rise time (ps)	22	166
Fall time	20	284
Short circuit current (μA)	7.67	18.93
Delay 50%(low to high)	1.70	167.97
Power (μW)	0.15	2.84
Peak current (μA)	7.8	1.69
Total delay (ps)	3.70	256.89

Table 1. Comparison of CNFET and CMOS

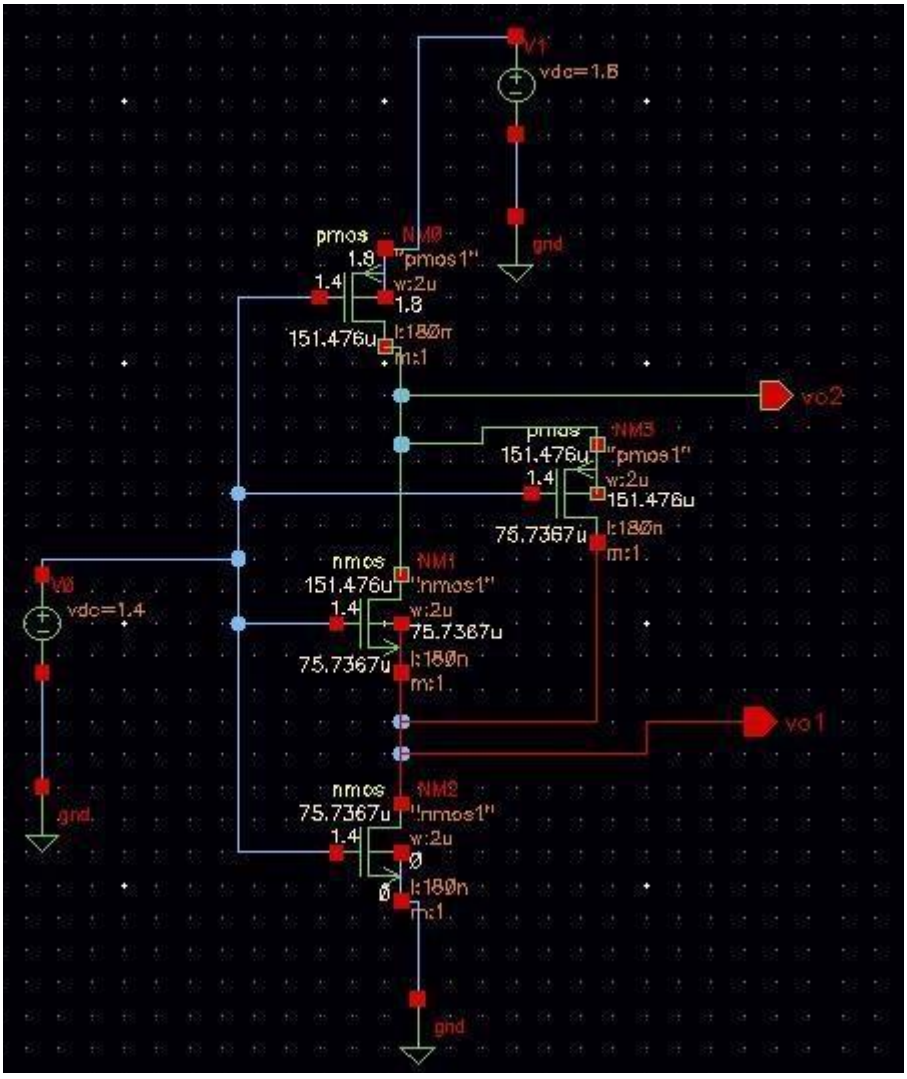

Fig 3. Modified analog circuit using CNTFETs

V. RESULT & SIMULATION

FIG 4. POWER DISSIPATION OF CIRCUIT

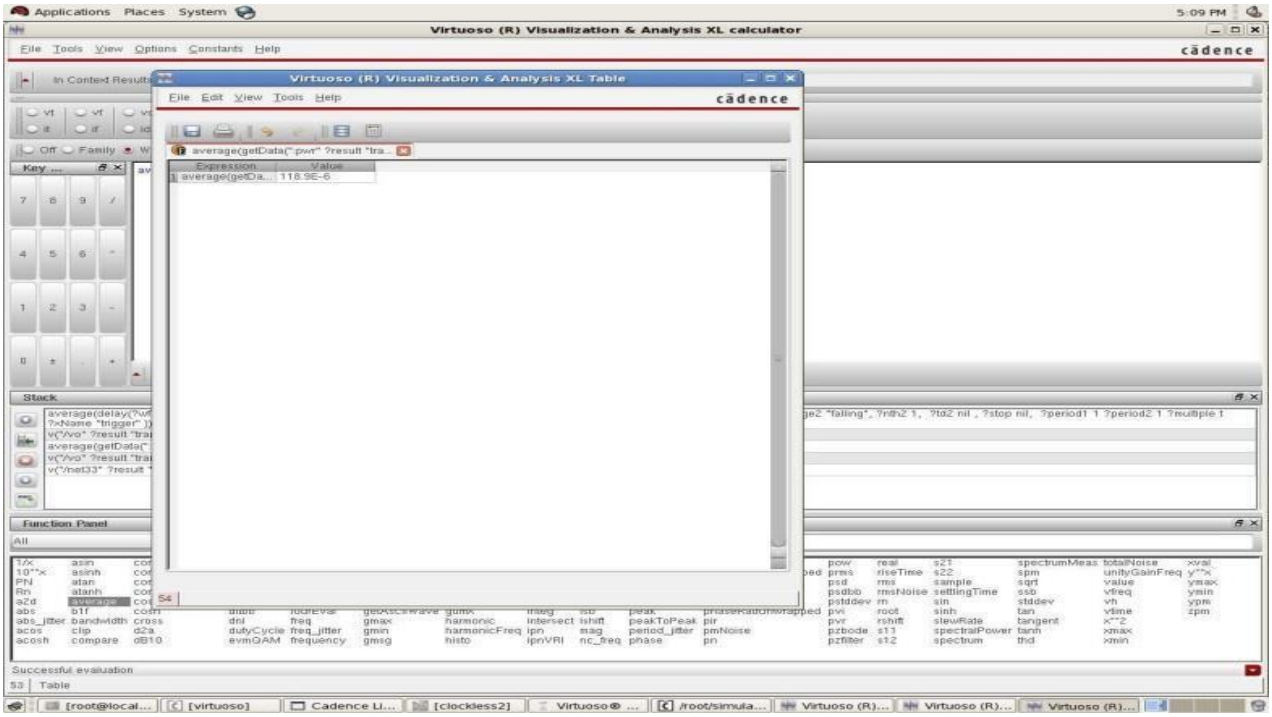

Fig 5 Power estimation of CNTFET Based Analogy circuit

VI. CONCLUSION

Today we are using CMOS technology in every field, but further scaling of silicon based transistors will not be possible at advanced stages thus CNTs will be of great use. In this paper multi stable analog circuit using 180nm technology is replaced by CNTFET based analog circuit and calculation of power estimation is done using CADENCE software tool.

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