Design and Performance of CMOS Circuits in MICROWIND

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ABSTRACT
This paper describes the experience in teaching integrated circuit design using an educational tool called Microwind through a Project-Based Learning approach. The demand and popularity of portable electronics is driving designers to strive for small silicon area, higher speeds, low power dissipation and reliability. Our work presents the design and performance of 8-bit Ripple Carry Adder using CMOS, transmission gates and pass transistor circuits. The schematic design is further converted into prefabrication layout. Simulation of the schematic and layout realizations of the adder is performed and results are discussed. Such tool is highly applicable in the design approaches towards the rural development.

Keywords
CMOS, transmission gates, pass transistors, layout, power consumption, rural development.

1. INTRODUCTION
"CMOS" refers to both a particular style of digital circuitry design, and the family of processes used to implement that circuitry on integrated circuits (chips). CMOS circuitry dissipates less power than logic families with resistive loads. Since this advantage has increased and grown more important, CMOS processes and variants have come to dominate, thus the vast majority of modern integrated circuit manufacturing is on CMOS processes. In our paper we have presented a brief review of Ripple Carry Adder using CMOS, Transmission gates and Pass transistor circuits. The basic circuit diagram of 1- Full Adder is as shown below along with the block diagram and its truth table.

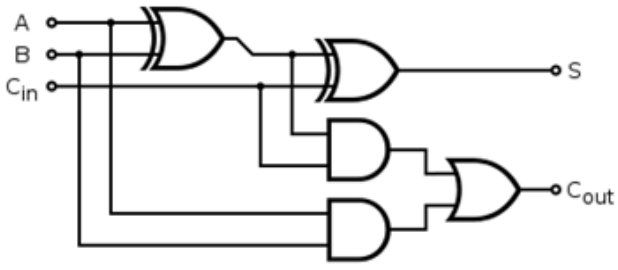

Fig.1: Circuit Diagram of 1-bit adder

A	B	C_{in}	C_0	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Fig.2: Truth table of 1-bit Adder

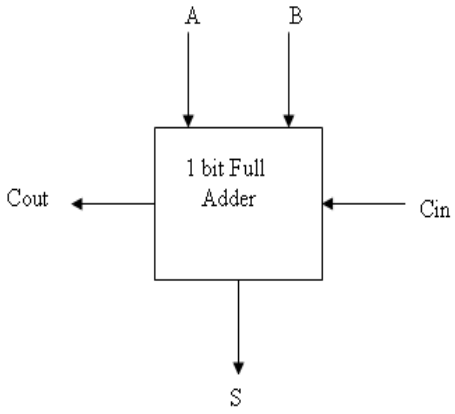

Fig.3: Block diagram of 1-bit Adder

2. CIRCUIT TECHNIQUES

2.1 Ripple Carry Adder (8 bit)
Full adder: -The full-adder circuit adds three one-bit binary numbers (A,B,Cin) and outputs two one-bit binary numbers, a sum (S) and a carry (Count).
Ripple carry adder: It is possible to create logical circuit using multiple full adders to add N (pre case 16) bit numbers. Each full adder inputs a Cin (Carry input) which is the Cout (Carry output) of previous adder. This kind of adder is ripple carry adder since each carry bit ripples to the next full adder.

2.2 8-bit Ripple Carry Adder using CMOS circuits

CMOS is also sometimes referred to as complementary-symmetry metal–oxide–semiconductor (or COS-MOS). The words "complementary-symmetry" refer to the fact that the typical digital design style with CMOS uses complementary and symmetrical pairs of p-type and n-type metal oxide semiconductor field effect transistors (MOSFETs) for logic functions

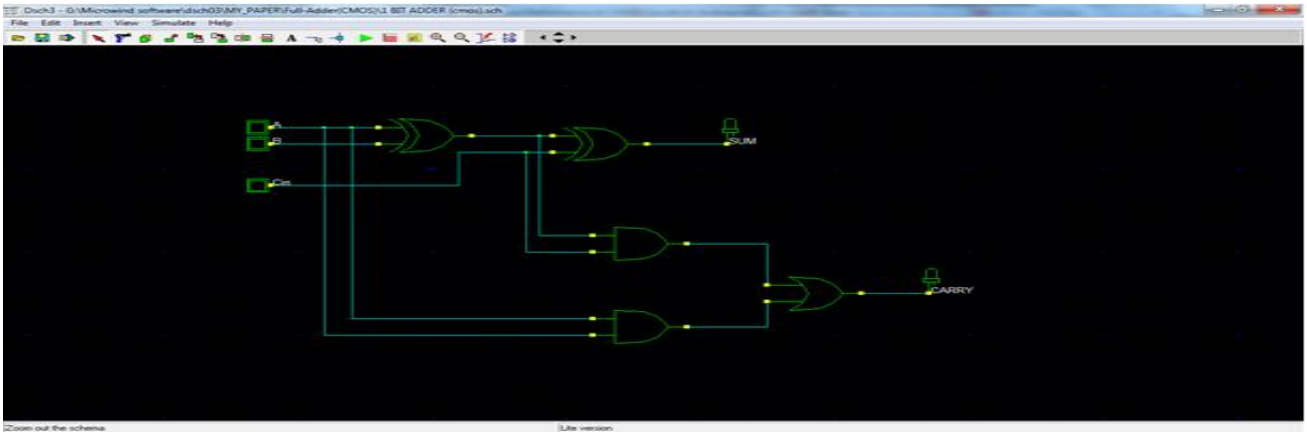

Fig.4: One-bit Ripple Carry Adder using CMOS circuits

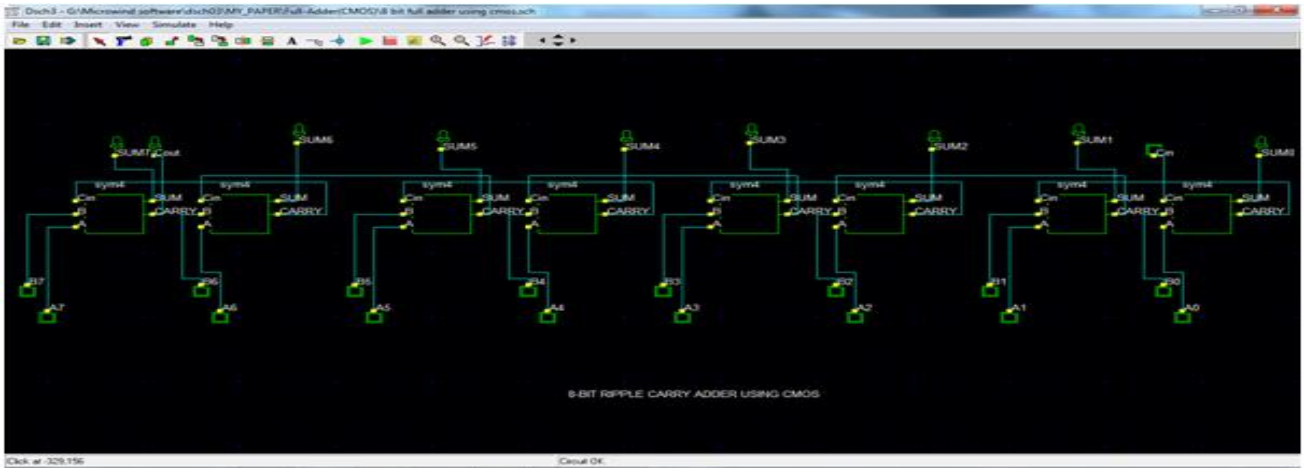

Fig.5: Eight-bit Ripple Carry Adder using CMOS circuits

2.3 8-bit Adder using Transmission gates

The CMOS transmission gate consists of two MOSFETs, one n-channel responsible for correct transmission of logic zeros, and one p-channel, responsible for correct transmission of logic ones.

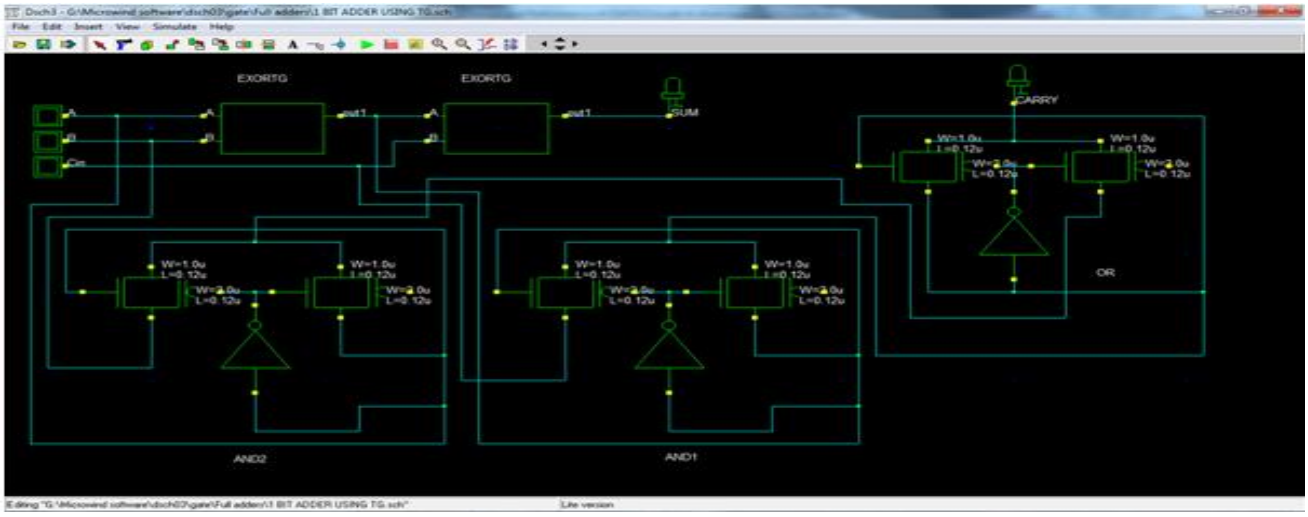

Fig.6: One-bit Ripple Carry Adder using Transmission Gates

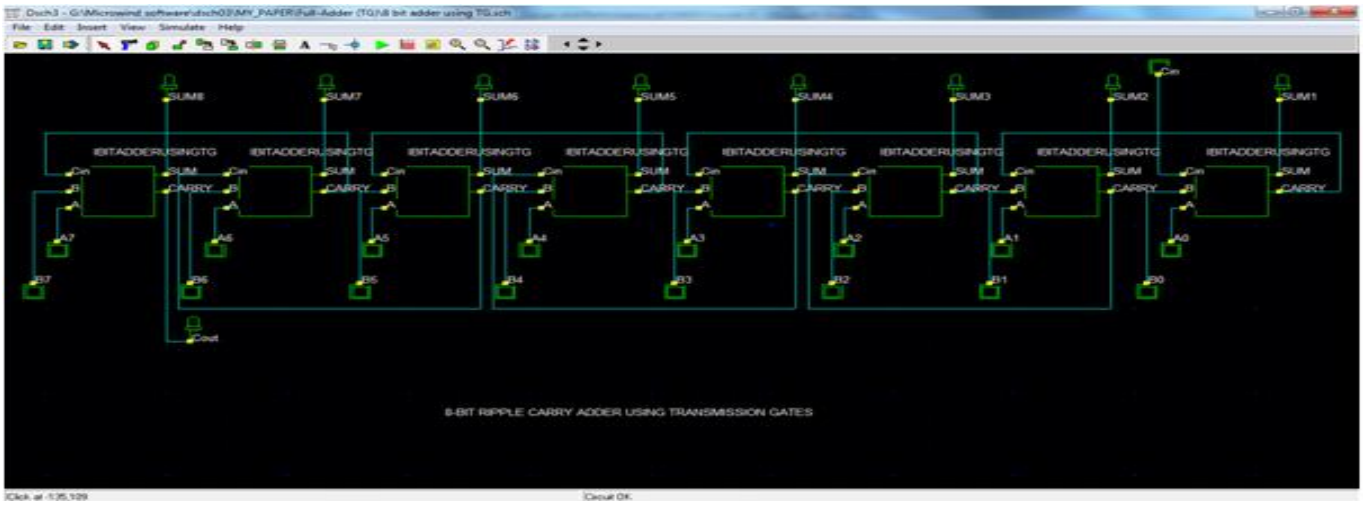

Fig.7: Eight-bit Ripple Carry Adder using Transmission gates

2.4 8-bit Adder using Pass transistors

We can view the complementary CMOS gate as switching the output pin to one of power or ground. A slightly more general gate is obtained if we switch the output to one of power; ground; or any of the input signals. In such designs the MOSFET is considered to be a pass transistor. When used as a pass transistor the device may conduct current in either direction.

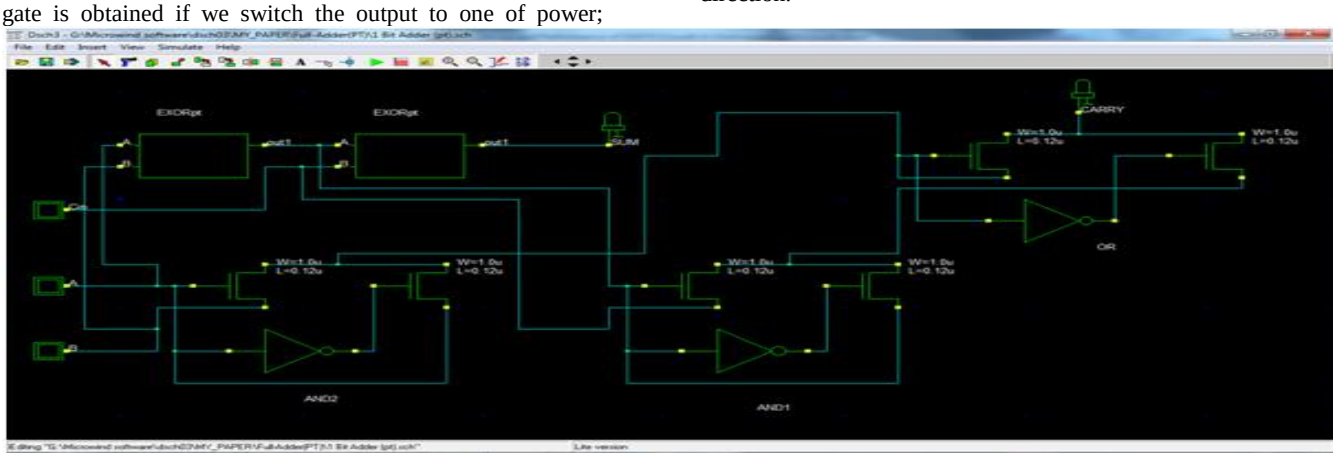

Fig.8: One-bit Ripple Carry Adder using Pass Transistors

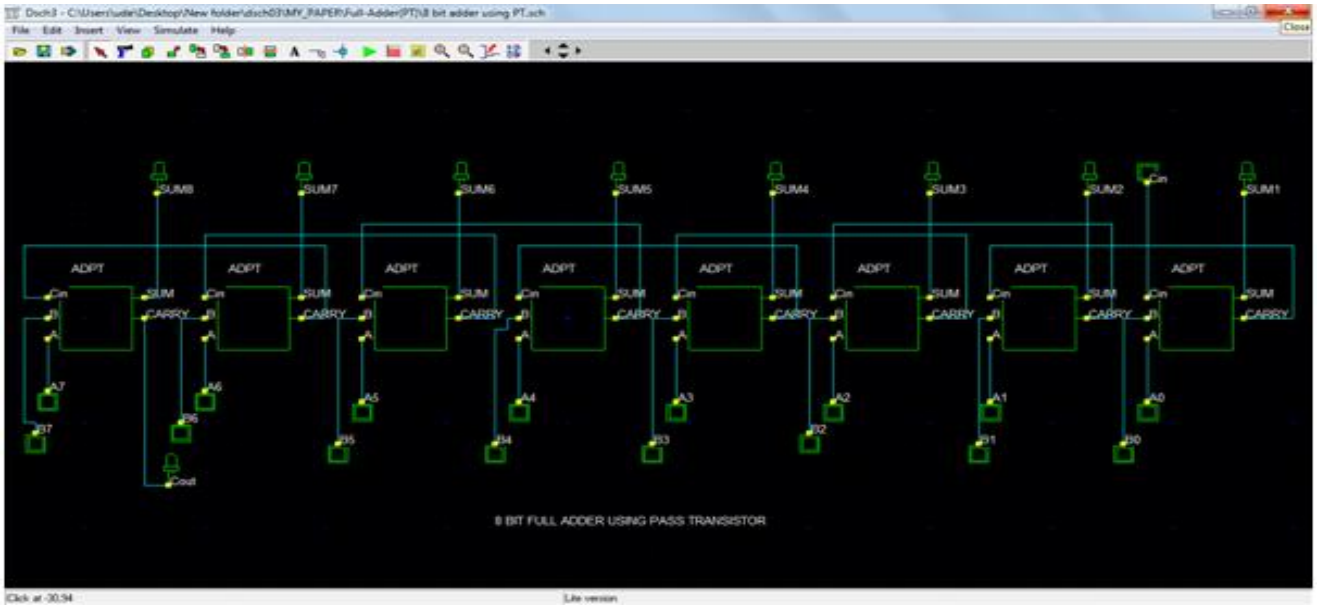

Fig.9: Eight-bit Ripple Carry Adder using Pass Transistors

3. DESIGN AND LAYOUT ASPECTS

Figures 10,11 and 12 shows the layouts of 8–bit Ripple Carry Adder using CMOS, Transmission gates and Pass transistors respectively.

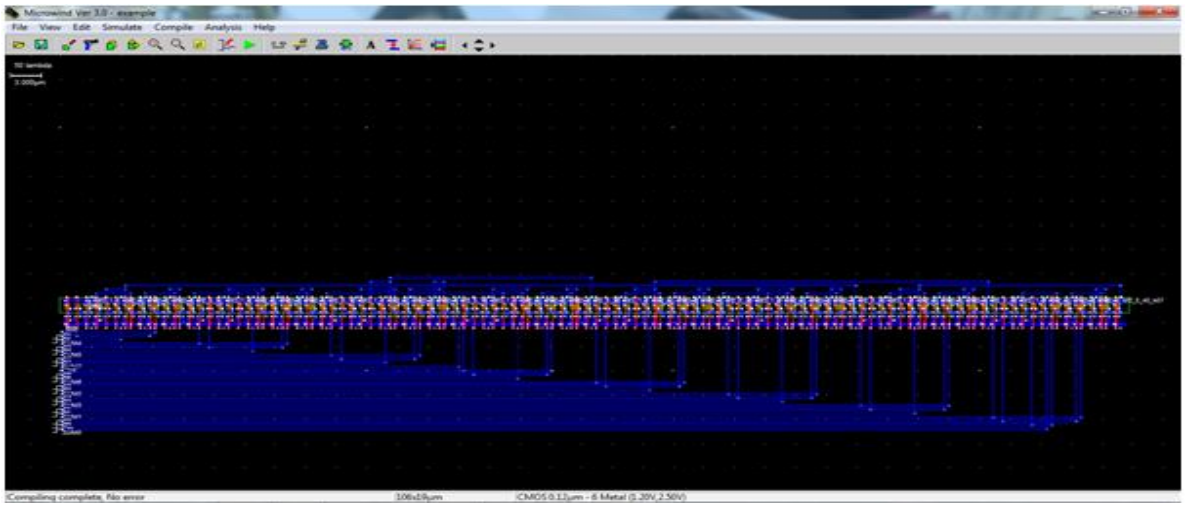

Fig.10: Layout of 8-bit Ripple Carry Adder using CMOS

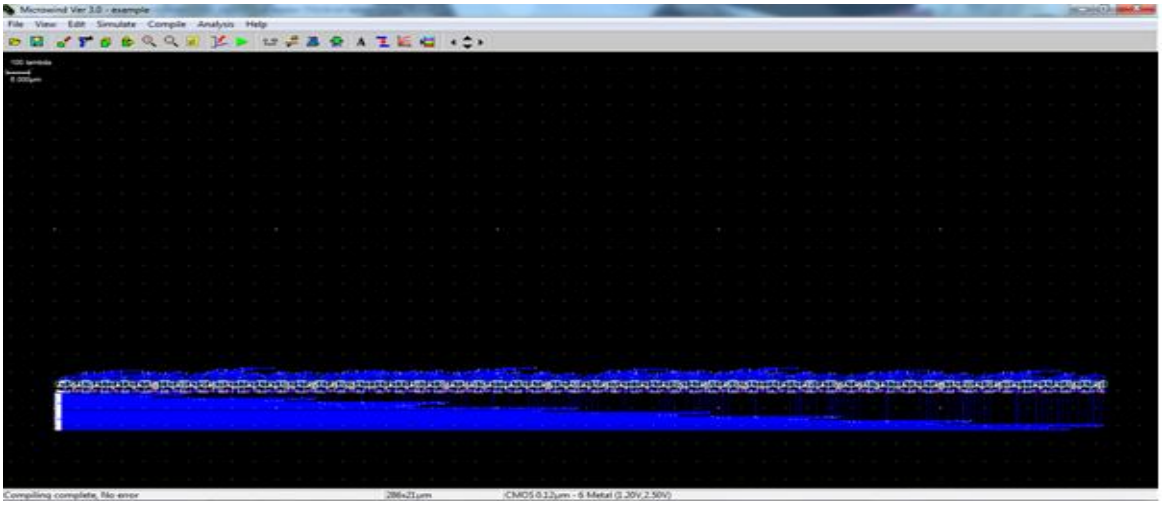

Fig.11: Layout of 8-bit Ripple Carry Adder using Transmission gates

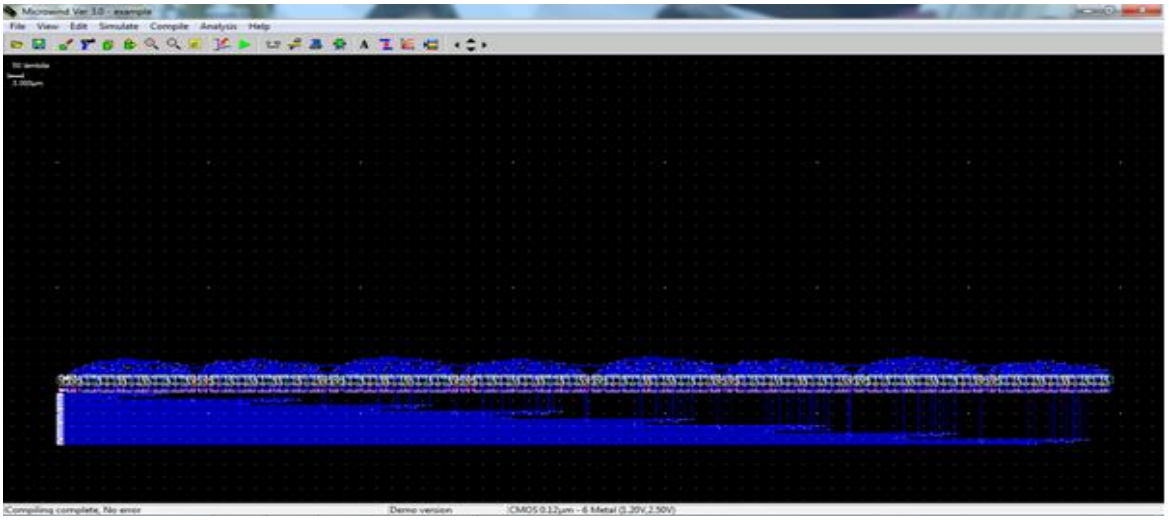

Fig.12: Layout of 8-bit Ripple Carry Adder using Pass Transistor

4. SIMULATION AND RESULTS

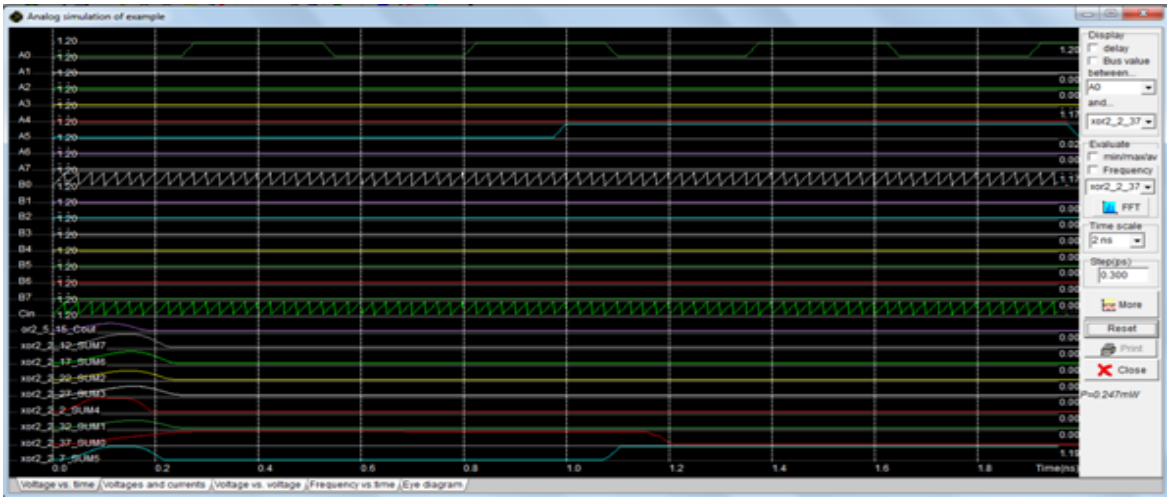

Fig.13: Simulation results of CMOS

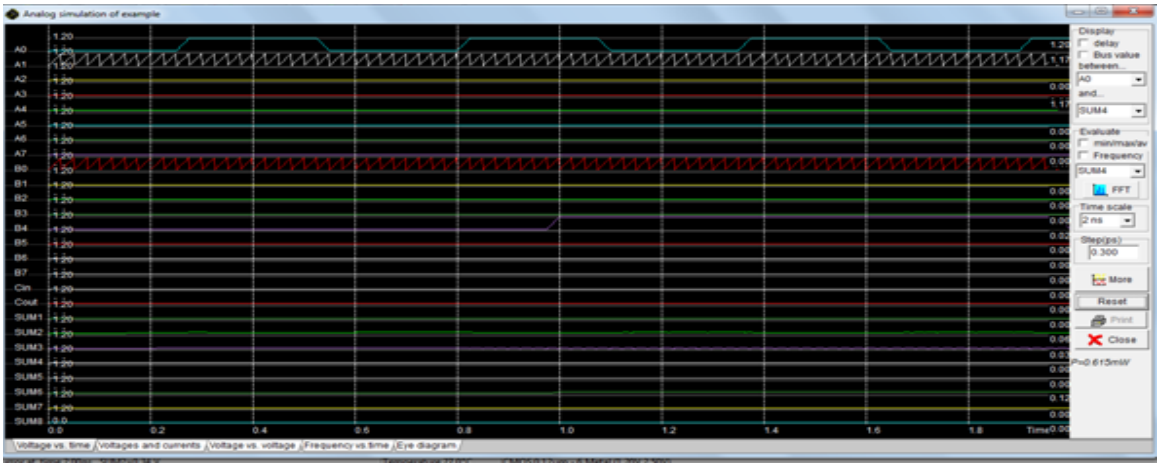

Fig.14: Simulation results of Transmission Gates

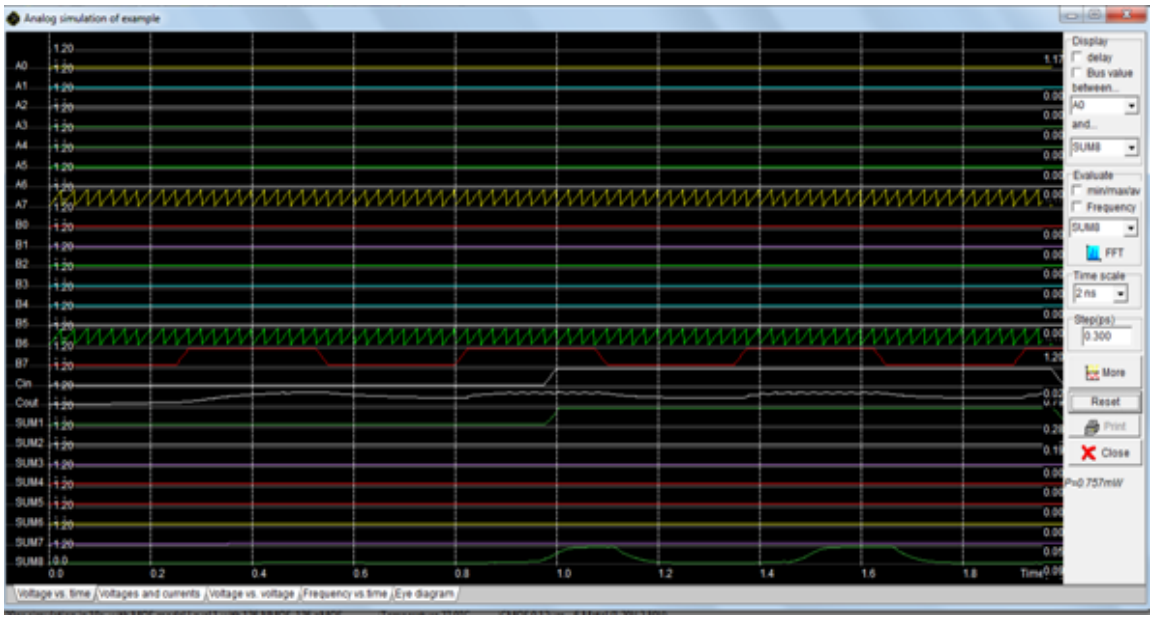

Fig.15: Simulation results of pass transistors

The table 1 below shows the results of 8-bit ripple carry adder using CMOS circuits, Transmission gates and Pass Transistors. It compares these circuits regarding Power dissipation. Fig. Below represents the above results graphically.

Table 1

Circuits	Power Dissipation (mW)
CMOS Circuits	0.247 mW
Transmission Gates	0.757 mW
Pass Transistors	0.615 mW

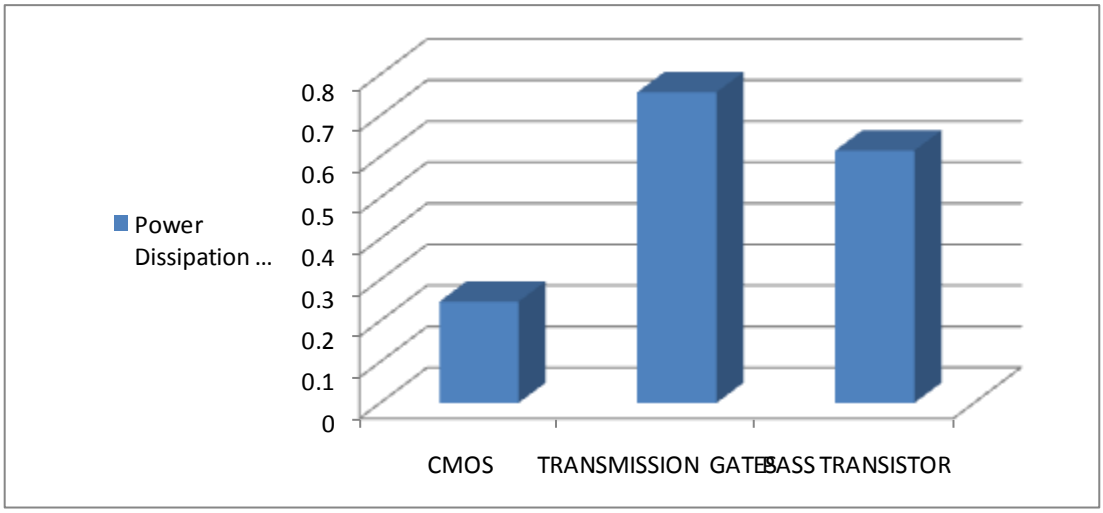

Fig. 16: Power Dissipation of 8-bit Ripple Carry Adder

5. CONCLUSION

In this paper, an attempt has been made to design 2input AND, 2input OR, 2input XOR, which are the basic building blocks for the benchmark circuits 8- bit Ripple carry adder. The proposed circuits have offered an improved performance in power dissipation. In this research work, we can be concluded that as the power dissipation of CMOS circuits is much less than the power dissipation of Transmission gates and Pass transistors, thus it proves to be much efficient than the circuits from Transmission gates and Pass transistors. The circuit and its VLSI technology is very useful in the applications related to rural development as it is less power consuming and thus can be efficiently used in various technologies for better growth of rural areas.

6. REFERENCES

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