NANOELECTRONICS IMPLEMENTATION OF LOGIC AND/OR WITH MEMRISTORS

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ABSTRACT

A memristor is a two terminal passive component which is a non-linear circuit element relating to charge, q and magnetic flux linkage, ϕ [5]. This research focuses on implementing the component into hybrid electronic device that would give identical result to its identical device which is fully CMOS structured. The research include integrating spice-model of the memristor into appropriate software for simulation, analysis on particular aspects which is the speed and power dissipation and then comparing the hybrid of the CMOS and memristor to a more familiar full CMOS device. The logic AND and OR device aspects of the hybrid is similar, only the full adder output sum did not match. According to the analysis, the hybrid design would give better power dissipation and smaller layout size compared to the fully integrated CMOS design only its disadvantage is at its speed but would be solved by implementing buffer to the output, without overcompensating the size of the design.

Keywords— Memristor, Hybrid CMOS-memristor, Logic AND, Logic OR, full adder.

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CHAPTER 1

INTRODUCTION

1.1. Project Background

The breakthrough of a new passive device element was discovered in 2008 by the HP Labs team. The transistors has been used as the basic building block in electronic devices since the creation of the transistor which comes to its prime in1956[1]. The transistor was much bigger than nowadays hence the shrinking of the transistors was inevitable in order to construct much better devices which starts subsequently as soon as the researchers realize the potential of it. Intel co-founder Gordon E. Moore has said that in years to come the number of components in and integrated circuit, will double every year [2][3], whereby it has so far been proven true. Up comes R. Stanley Williams the head researcher of HP labs team, which was established in 1995 by David Packard the co-owner of Hewlett Packard cooperation, the shrinking of the transistor has to stop or better yet will stop in the. Moore's Law, the semiconductor industry's obsession with the shrinking of transistors and their commensurate steady doubling on a chip about every two years, has been the source of a 50-year technical and economic revolution. But the shrinking process is nearing its end which could be approximated by the time it shrinks to an atomic size [4]. This limitation might be prolonged with the realization of the fourth passive element, the memristor.