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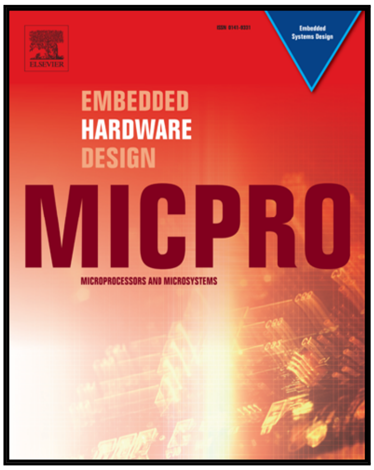

Quantum-Dot Cellular Automata Circuits with Reduced External Fixed Inputs

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Abstract
Nanotechnologies, notably quantum-dot cellular automata, have achieved world-wide attentions for their prominent features as compared to the conventional CMOS circuitry. Quantum-dot cellular automata, particularly owning to its considerable reduction in size, energy consumption and latency of circuits, is considered as a potential alternative for the CMOS technology. Considering the manufacturing aspects, in this paper, a method is proposed for designing efficient quantum-dot cellular automata circuits. We inspect an alternative approach for streamlined design of quantum-dot cellular automata circuits such that the required external fixed inputs are substantially reduced. In order to demonstrate the efficiency of the proposed method, the widely used multiplexer, XOR and party generator circuits are considered as case studies. All of the proposed circuits are simulated and verified using QCADesigner which is a valid and popular simulation tool. Comparisons indicate that the proposed method considerably reduces the number of external fixed inputs which simplifies the overall circuit implementation and fabrication.

Keywords: Quantum-dot cellular automata (QCA); Fixed cells; Multiplexer; Nanoelectronics

1. Introduction

In recent decades, due to the appearance of serious constraints against physical scalability of the complementary metal oxide semiconductor (CMOS) technology, many problems and shortcomings have been identified. Some of these difficulties inherent to this technology are high leakage power consumption and short channel effects [1-3].

Several alternative nanotechnologies such as single electron technology (SET), nanowire transistor, carbon nanotube field effect transistor (CNTFET), and quantum-dot cellular automata (QCA) have already been suggested for the CMOS technology to resolve these drawbacks. Among the alternative solutions, QCA has attracted much more attention as it has provided ultra-low-energy consumption, fast operation and high device density [4].

There exist two positions in each QCA cell which can encode the binary information. The majority gate plays a significant role in the circuits designed based on the QCA technology. Using the majority and inverter gates enables designers to create any functions based on QCA technology [5]. Logic gates implemented using majority gates need some fixed inputs which are provided using fixed input cells. Because of the difficulties regarding fixed driver input cells during the physical design such as placement and routing of complex circuits as well as the fabrication complexity and cost, designers need to use a new approach to resolve this problem.