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OPTIMIZED IMPLEMENTATION OF REVERSIBLE PRIORITY ENCODER USING NANO QCA

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Abstract

Quantum-dot cellular automata (QCA) is a possible replacement for complementary metal–oxide–semiconductor technology (CMOS). With the help of reversible computing, it is possible to attain zero power dissipation. The design of a reversible priority encoder based on QCA is proposed in this work. Peres and BJN gates are the design's foundational elements. The QCA designer simulator verifies the suggested design. The performance analysis is implemented based on the simulation results. The proposed encoder reduces the amount of heat energy dissipation, producing quality data also solving the problem of the jumbled data. The proposed reversible circuit has the potential to be a game changer. Since reversible logic circuit provides zero information loss, it will be a key component in future wireless communication. The estimated energy dissipation of suggested QCA circuits is investigated, implying that QCA could be a suitable platform for implementation of Reversible circuits.

Keywords - *Quantum dot Cellular Automata(QCA), Reversible logic , priority encoder.*

I. INTRODUCTION

In nano scale logic design, power consumption is the most challenging area[5]. Hence, there is a raising requirement for a new technology that can provide nano size circuits having lesser power dissipation. This need is satisfied by QCA Technology[8]. QCA offers high device density, low power consumption and high switching speed[6]. Due to these properties quantum gates have been targeted for their enabling roles towards computational reversibility. Irreversible computing do not conserve information and dissipation of heat is high. This limitation is the main driving force which draws the attention of reversibility.

FUNDAMENTALS OF QCA

A. QCA CELL

In contrast to electronics based on transistors, QCA does not operate by the transport of electrons, but by the adjustment of electrons in a small limited area of only a few square nanometers[26]. QCA is implemented by quadratic cells, the so-called QCA cells. In these squares, exactly four potential wells are located, one in each corner of the QCA cell (see figure 1.1). In the QCA cells, exactly two electrons are locked in. They can only reside in the potential wells.

The potential wells are connected with electron tunnel junctions. They can be opened for the electrons to travel through them under a particular condition, by a clock signal. Without any interaction from outside, the two electrons will try to separate from each other as far as possible, due to the Coulomb force that interacts between them. As a result, they will reside in diagonally located potential wells, because the diagonal is the largest possible distance for them to reside.

A basic QCA cell consists of four quantum dots in a square array.

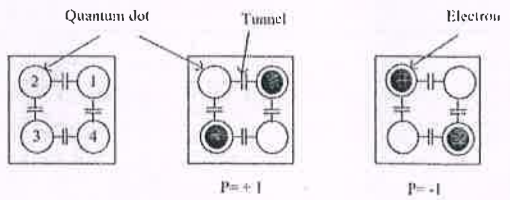

Figure 1.1 QCA cell

Electrons occupy two dots in the furthest site due to mutual electrostatic repulsion. In QCA, logic values are stored based on electron's charge rather than electrical pulse like in CMOS[25].