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Six-Correction Logic (SCL) Gates in Quantum-dot Cellular Automata (QCA)

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Abstract - Quantum Dot Cellular Automata (QCA) is a promising nanotechnology in Quantum electronics for its ultra low power consumption, faster speed and small size features. It has significant advantages over the Complementary Metal-Oxide-Semiconductor (CMOS) technology. This paper present, a novel QCA representation of Six-Correction Logic (SCL) gate based on QCA logic gates: the Maj, Maj AND gate and Maj OR. In order to design and verify the functionality of the proposed layout, QCADesigner a familiar QCA simulator has been employed. The simulation results confirm correctness of the claims and its usefulness in designing a digital circuits.

Keywords—Quantum Cellular Automata; QCA Logic Gates; QCA Six-correction logic (SCL) gates.

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I. INTRODUCTION

Quantum cellular automata (QCA) have been used widely to digital circuits and systems. QCA technology is a promising alternative to CMOS technology. It is attractive due to its fast speed, small area and low power consumption, higher scale integration, higher switching frequency than transistor based technology. QCA functions are based on Columbic interaction instead of current used in CMOS, so there is no leakage current. Additionally, it has major advantages such as low power consumption, high speed and small space consumption. QCA was presented in (Porod, W., 1997) for the first time and many sequential, combinational and reversible circuits have been introduced so far (Porod, W., 1997; Tougaw *et al.*, 1994; Wang *et al.* 2003; Zhang *et al.* 2005; Huang *et al.* 2007; Bhagyalakshmi *et al.* 2010; Sen *et al.* 2013; Bahar *et al.* 2013a; Bahar *et al.* 2013b; Islam *et al.* 2014; Bahar and Waheed 2014; Sarker *et al.* 2014; Bahar *et al.* 2015a; Bahar *et al.* 2015b). The basic structure in QCA is a cell that has four dots positioned at the corners of the squared cell and two free electrons. Each dot can be occupied by one of the two hopping electrons shown in figure 1.

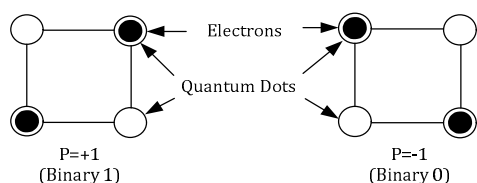


Figure 1. QCA cell and the two stable polarizations

Since the mutual behavior of the electrons is based on the Columbic interaction, they arrange themselves diagonally in order to reach to the maximum distance. Electrons can tunnel between dots through the barriers but cannot leave the cell; hence, there is no current flow. As shown in Figure 1 two stable polarization (p) states might occur, which represent the binary values “0” and “1”.

In order to implement gates and circuits, QCA benefits from Columbic interaction between cells. An array of cells that are aligned can construct a QCA wire which is shown in Figure 2. The polarization of each cell in a QCA wire is directly affected by the polarization of its neighboring cells on account of electrostatic force. Accordingly, QCA wires can be used to propagate information from one end to another (Kim *et al.*, 2007).

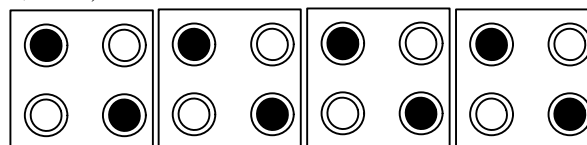


Figure 2. QCA wire

Two fundamental QCA gates are the inverter and the majority gate. Many structures are implemented based on these two gates like the AOI (Huang *et al.*, 2004), the complex gate (Townsend, W. J., & Abraham, J. A., 2004) and one bit QCA full adder (Kim *et al.*, 2007; Swartzlander, *et al.*, 2010; Sayedsalehi *et al.*, 2011). Figure 3 show three types of inverter gate; however, since the last one operates properly in all various circuits, it is used more in different designs



Non Oblivious Watermarking Technique for JPEG2000 Compressed images using Arnold Scrambling of Unequal Size Watermark Blocks

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Abstract: -In this paper, a watermarking technique for JPEG2000 compressed image is proposed. Scrambling of secret message is performed block-wise using Arnold Transform. Secret message is divided into non-overlapping blocks of unequal size and then Arnold transform is applied on each block and secret key is generated based on the periodicity of each block. Scrambled secret message is embedded into qualified significant wavelet coefficients of a cover image. After embedding the secret message into wavelet coefficients, the remaining processes of JPEG2000 standard are executed to compress the watermarked image at different compression rates. Scaling Factor (SF) is used to embed watermark into wavelet coefficients and the value of SF is stored into COM box of the code stream of JPEG2000 compressed image and this SF value and secret key are used to extract the embedded watermark on the receiver side. The performance of the proposed technique is robust to a variety of attacks like image cropping, salt and pepper noise, and rotation. Proposed technique is compared with the existing watermarking techniques for JPEG2000 compressed images to show its effectiveness.

Key-Words: JPEG2000, DWT, Arnold Transform, EBCOT, SF, COM

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I. INTRODUCTION

Recent years have witnessed the rapid development of the Internet and telecommunication techniques. Due to these developments, it has been possible to exchange large amount of data/information over a wide range of public networks. However, information transmitted through these networks may not be safe. For this purpose, information security techniques are used. Information hiding is one branch of information security, which hides the existence of information in a media such as digital image, videos and audios, etc. and then transmitted to the receiver where the authenticated user can extract the hidden data. Digital watermarking is one branch of

information hiding which is used to authenticate the owner of a digital media.

JPEG2000 is the new state of art image and video compression standard. It provides excellent performance and novel features such as superior low bit rate compression performance, lossless and lossy compression, progressive transmission, region of interest coding, error resilience and random code stream access etc. as compared to older image compression standards (Taubman and Marcellin, 2000; Christopoulos et al., 2000; Su et al., 2001). Development of techniques for protecting the owner's rights to a JPEG2000 compressed images has received devotion from research community. Several steganography and