International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 7, July - 2014

A Novel Structure for Image Negative using Quantum Cellular Automata Adder

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Abstract - Quantum computing is the growing interest in recent years. As it can bring significant improvement in speed,while decreasing the power consumption and size. Quantum cellular automata is the major tool used for quantum computing. QCA mainly deals with the placement of unbounded electrons in the cell. Image negative in an digital image processing has been implemented using conventional computers. The size and complexity of these computers are of great concern. This drawback can be overcome by using quantum cellular automata technique to implement image negative. There are lot of researches going on in image processing field but non has been able to deal with the problem of area, speed and power consumption. Image negative is a process of enhancing white or grey detail embedded in the dark regions of an image. Image negative has a great advantage in the field of medicine. Mammogram for early detection and screening of breast cancer is one of the best example of its application.

***Key words*: Mammogram, Image Negative, Full Adder and 2's Compliment.**

1. INTRODUCTION

Medical diagnosis refers to the process of identifying an abnormality or diseases from the symptoms or syndromes. In recent years the paradigm has shifted to computer aided analysis of output signals/images. Digital mammography is regarded as gold standard for breast cancer detection. In mammogram, lesions appear as low intensity region compared to background hence image negative is performed before image segmentation. Image negative refers to the point processing technique in which white pixel are converted into dark pixel and vice versa. It is achieved by subtracting every pixel from 255(k=8, number of bits used for representing pixel). In conventional machines this image subtraction is basically performed by an 8-bit full subtractor realised with micro meter CMOS technology. With the need for repeated shrinking, reduced size conventional CMOS devices are made in nano meter scale but this MOSFETs are affected by tunnelling of electrons between the barriers, jumping of electrons from gate to source leading to undesirable leakage current. Hence in nano computing, conventional CMOS switches are replaced with quantum cellular automata (QCA), spin devices and molecular bundles. Though considerable research is carried out to develop and synthesis highly effective nano devices, identifying application for these devices is more difficult. In this paper, an efficient QCA based image negative for digital mammogram is proposed. This paper is organised as follows: section 2 focuses on the recent application of QCA, section 3 provides an overview of QCA, section 4 describes proposed 8-bit full subtracted architecture using 2's compliment addition and section 5 concludes the research work and also provides future direction.

2. RECENT APPLICATION OF QCA

Barrera et al proposed implementation of multichannel filter using QCA. They introduced a new adaptive filter to remove impulsive noise and other abnormality from TV color signal. The following were the process for filtering: define a processing direction, threshold decomposition, binary filtering and adding. These pertain to different clock phases. It is used for processing digital signal. They used stack filter for reducing the time needed for the ordering of input samples and the utilization of logic gate.

Helsinguis et al studied the suitability of quantum dot cell for nonlinear signal processing. They stated the majority logic cell is a binary three point median. Suitable sorting networks and threshold decomposition is used to perform many nonlinear filtering operations. The majority logic require nonlinear filter design algorithms. Thermal noise increases with the cell size and temperature. The thermal noise does not affect the computation since the size of each sub circuit is small.

Qadir et al presented digital image scrambling using two dimensional cellular automata. the digital image scrambling included the following steps : apply the CA GoL rules to matrix A for k times,get gray value of pixel P(i,j) with A1(i,j)=1,take the grey values of remaining pixels of P(i,j)with A(i,j)=0 successively and put it in matrix P' by order and finally obtain the scrambled image p' The advantage of this scrambling scheme are better scrambling effect,confidentiality and higher security. This scheme is applicable for any size and any kind of digital image. They provided rules and algorithms for the images which are attacked by the salt and pepper noise. To reduce the noise and make the image smooth they used image Filtering

3. QCA AND OVERVIEW

A quantum dot cellular automaton refers to the communication through local interaction with adjacent QCA cell. A QCA cell consists of 4 quantum dot with two unbounded electrons in it. Due to columbic repulsion these electron s may occupy 1,3 states (Logic 1) or 2,4 states (Logic 0). These QCA cells are used for developing logical circuits. The conventionly developed logic circuit include quantum wire, inverters and majority gate. A majority gate consist of three input cell, one processing element and one output cell.

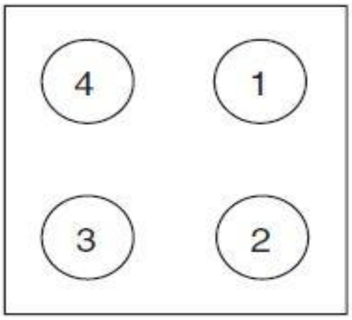


Fig-1: Numbering of the Quantum dots in a QCA cell used in this paper.

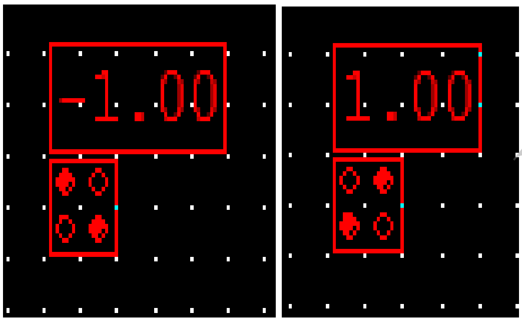
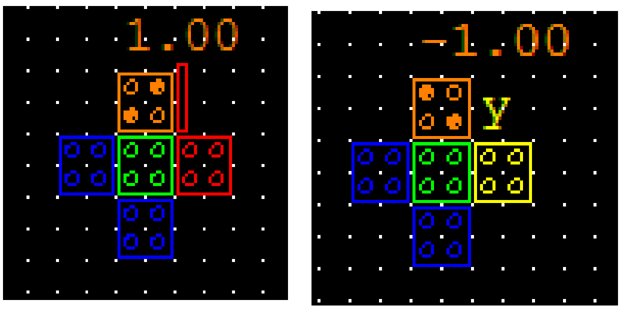


Fig-2: Two possible Ground states polarization of a QCA cell.



(a) (b)

Fig-3: The three-input majority gate.It is created from a cross pattern of five cells.

(a) shows OR logic that is at least one of the cells must be logic '1' for the output to be logic '1.'
(b) shows AND logic that is at least two of the cells must be logic '1' for the output to be logic'1'.

The output of the majority gate is equal to the most frequent input that is it performs majority Coating. For example if two or more inputs are 1 then the output is 1. Similarly if 2 or more input are 0 then the output is 0. A QCA wire is used for transferring the data.

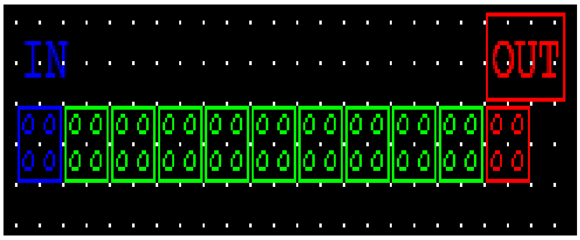


Fig-4: A QCA Wire using QCA cells.

4. PROPOSED METHODOLOGY

Digital image is defined as two dimensional function f(x, y) where x, y are spatial coordinates and f(x, y) denotes amplitude pixel and x, y, f(x, y) are finites (Gonzales and Woods) conventional every pixel is represented with 8 bit which means there are 256 gray levels in grayscale image. The range of intensities [0,255] i.e. 255 refers white pixels and zero represents black pixels. Image negative is governed by equation 1.

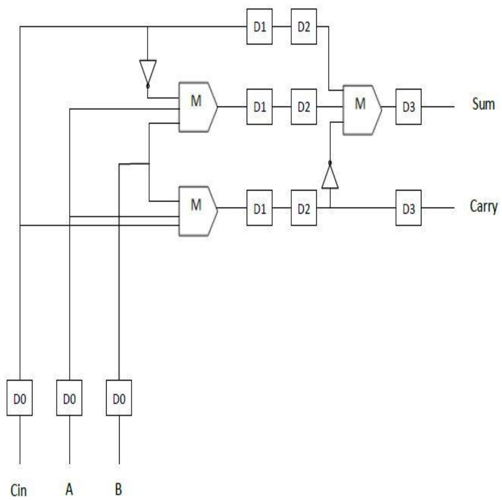
$$S=255-r \qquad \text{(Equation 1)}$$

Where r is the origin intensity & S is processed intensity

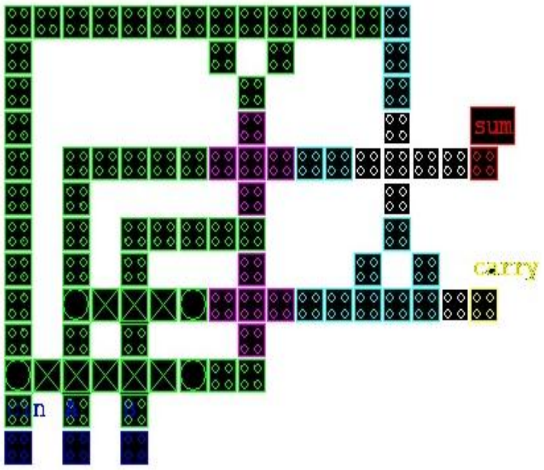
$$S=255+r'+1 \qquad \text{(Equation 2)}$$

Where r' represents 1's complement of r.

Thus image negative is performed as 2's complement addition. Hence a 8 bit full adder can be used for performing image negative. QCA based full adder circuit proposed by in [bionic] is shown in fig (5).



(a)



(b)

Fig-5: (a),(b)Majority gate based full adder schematic and layout .

Table-1:The truth table for full adder

Cin	A	B	SUM	CARRY
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

From the truth table, it is inferred that
Sum= Majority ((Majority (C_{in}, A, B))', Majority (C_{in}', A, B), C_{in})
Carry=Majority (C_{in}, A, B)

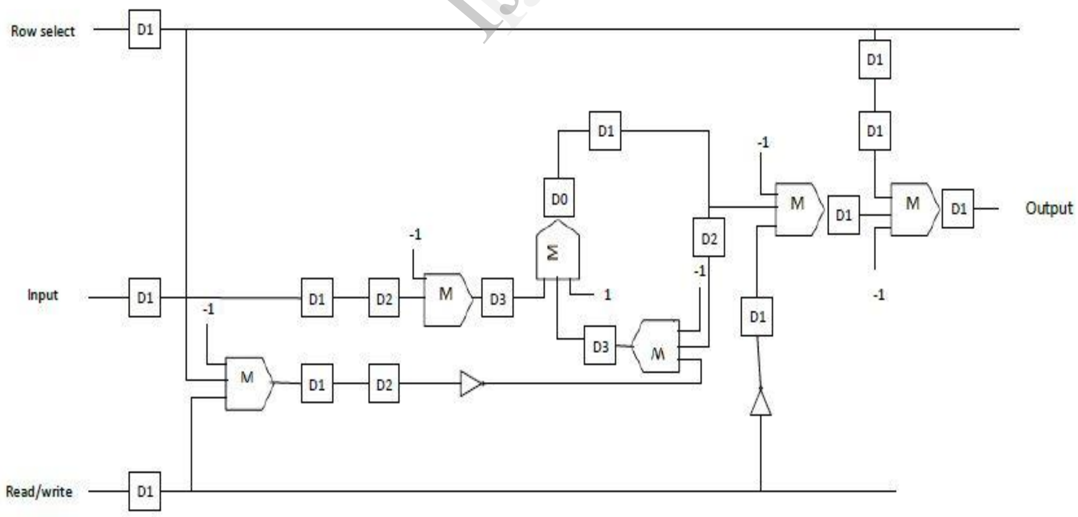


Fig-6: schematic of 1 bit memory cell.

From the basic QCA Adder an 8 bit image negative operation is proposed using 2's compliments arithmetic.

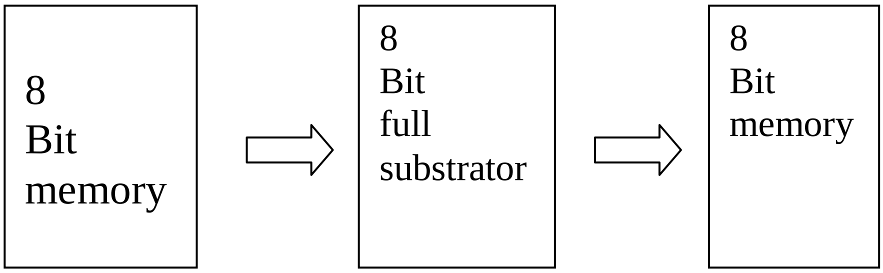


Fig-7: schematic of 8 bit QCA adder based image negative.

$S= 255+ (A^1+1)$
$S= 11111111_2 + (A_7', A_6', A_5', A_4', A_3', A_2', A_1', A_0'+ 1)$
$S_i = \text{Majority}((\text{Majority}(C_{i-1}, A_i^1, 1)), \text{Majority}(C_{i-1}^1, A_i^1, 1), C_{i-1})$
$C_i= \text{Majority}(C_{i-1}, A_i^1, 1)$
$C_0= 1$
Let $A= (11111110)_2$
$S_i= 00000001$

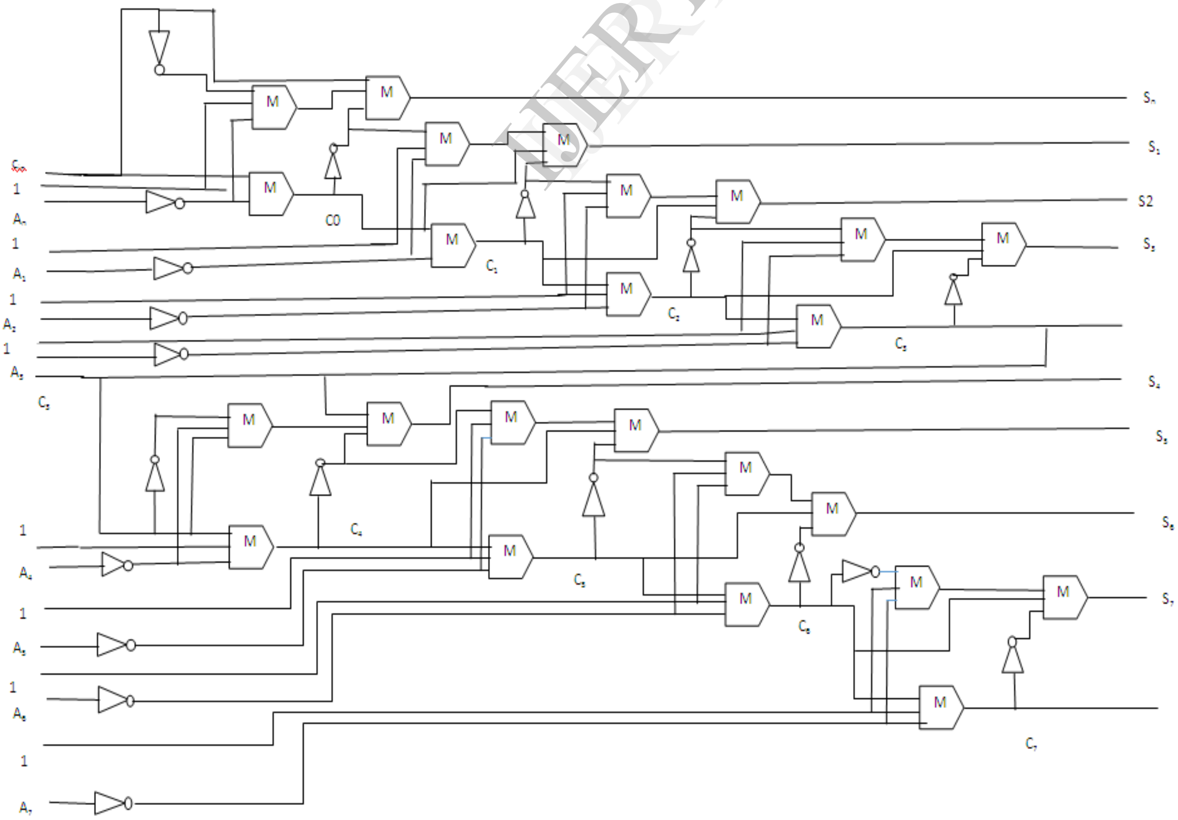


Fig-8: Proposed Methodology.

5. CONCLUSON AND FUTURE WORK

In This paper, QCA based image negative has been successfully proposed for digital mammograms in the proposed technique 8-bit adder is implemented using 2's complement addition. One bit full adder has been simulated using QCA and the results are verified logically. The output of the designed circuit is verified and validated for known inputs. However 8-bit full adder is yet to be simulated using QCA designer tool. Also proposed technique requires such 8-bit full adder blocks for an entire image. Owing to the nano meter scale of QCA adder such replication will not be a serious problem area wise even when compared to the conventional sub nano meter CMOS technology.

6. REFERENCE

[1]. Mary Mehrnoosh Eshaghian-Wilner , "Bio inspired and Nano Scale Integrated Computing", John Wiley and Sons,2009.

[2]. J.L. Cardenas-barrera, K.N. Plataniotis and A.N. Venetsanopoulos ,QCA implementation of a multichannel filter for image processing, Mathematical problems in engineering, 2002, vol.8,pp.87-89.

[3] T. Roska, J. Hámori, E. Lábos, K. Lotz, L. Orzó, J.Takács, P. L. Venetianer, Z. Vidnyánsky, and Á.Zarándy, "The use of CNN models in the subcorticalvisual pathway," IEEE Trans. Circuits and Systems-I:Fundamental Theory and Applications,vol. 40, no. 3,pp. 182 - 195, March 1993

[4] C. S. Lent and P. D. Tougaw, "A device architecture for computing with quantum dots," Proc. of The IEEE, vol. 85, no. 4, pp. 541 - 557, April 1997.

[5]. Mika Helsingius, Pauli Kuosmanen, and Jaakko Astola, Quantum-Dot Cells And Their Suitability For Nonlinear Signal Processing, Signal Processing Laboratory, Tampere University of Technology.

[6] P.D. Tougaw, C. S. Lent, and W. Porod, C. S. Lent,"Bistable saturation in coupled quantum-dot cells," J.Appl. Phys. 74, pp. 3558 - 3566, Sep. 1993.

[7]. Fasel Qadir1, M. A. Peer2, K. A. Khan3,Digital Image Scrambling Based on Two Dimensional Cellular Automata,I. J. Computer Network and Information Security, 2013, 2, 36-41.

[8] C. S. Lent and P. D. Tougaw,A device architecture for computing with quantum dots,Proceeding of the IEEE,85(4),541-557.

[9] C. S. Lent and P. D. Tougaw, logical devices implemented using quantum cellular automata,Journal of applied physics,75(3),1818-1825.

[10] I.Pitas,and A. N. Venetsanopoulos, Nonlinear digital filters, principles and applications. Kluwer, Norwell,p. 392, USA 1990.

[11] J. V. Neumann, ―Theory of self-reproducing automata,‖ University of Illinois Press, 1966.

[12] X. Desheng and X. Yueshan, ―Digital image scrambling based on Josephus traversing,‖ Computer Engineering and Applications, vol. 10, 2005.

[13] Y. Xu, G. Chen and J. Yu, ―A hybrid optimization method based on cellular automata and its application in soft-sensing modelling,‖ Proc. of Third International Conference on Natural Computing, IEEE press, 2008, pp. 1-5.

[14] P. Rendell, ―Turing universality of the game of life. In Andrew Adamatzky,‖ Editor,Collision-Based Computing, Springer, 2002.

[15] X. Desheng and X. Yueshan, ―Digital image scrambling based on Josephus traversing,‖Computer Engineering and Applications, vol. 10, 2005.