DESIGN AND IMPLEMENTATION OF 8X3 ENCODER USING QUANTUM-DOT CELLULAR AUTOMATA

Dhrubajyoti Bhowmik1, Apu Kr Saha2, Paramartha Dutta3

Abstract - Quantum-dot Cellular Automata (QCA) is one of the most substitute developing nanotechnologies for electronic circuits, as a result of lower force utilization, higher speed and smaller size in correlation with CMOS innovation. The essential devices, a Quantum-dot cell can be utilized to logic gates and wires. As it is the key building block on nanotechnology circuits. By applying simple gates the hardware requirements for a QCA circuit can be decrease and circuits can be less complex as far as level, delay and cell check. This article exhibit an unobtrusive methodology for actualizing novel upgraded simple and universal gates, which can be connected to outline numerous variations of complex QCA circuits. Proposed gates are straightforward in structure and capable as far as implementing any digital circuits. The main aim is to build 8x3 Encoder in a simple circuit. Simulation results and physical relations affirm its handiness in actualizing each advanced circuit.
Keywords – Nano-electronics, Quantum cellular automata, Encoder, Majority logic, QCA designer.

1. INTRODUCTION
As in light of the fact that the current CMOS innovation faces diverse challenging issues like high power utilization and can’t overlook the challenges in highlight measure decrease. A helpful summarization report of future advancements has been published by ITRS [2]. Trusting on the unique properties of electronic devices at Nano level feature size, nanotechnology unlocks new prospects for computing systems and devices. QCA proposed by Lent [3], is an emerging technology that offers an innovative approach for computing at nano-scale by monitoring the position of a single electron. QCA innovation has feature like rapid, amazingly low power, quick exchanging speed [4] and significantly more thick circuit [4-5], which increases clock frequency of logic circuits and decreases the size and estimated power consumption of those circuits [6]. XOR gate is presumably an imperative part of numerous advanced outlines of complex advanced circuits. The research article propose an advanced encoder by which any complex computerized circuit can be implemented , here we execute advanced XOR circuit using normal wire .There are different clocking plans, for example, wave clocking which might be more reasonable for molecular QCA. Quantum technology has gradually applied in various fields, Quantum dot cellular automata are projected as a promising nanotechnology for future nano ICs. QCA innovation depends on the association of bi-stable [7], [8] QCA cells constructed from four quantum dots. The cell is accused of the assistance of two free electrons which are able to tunnel between adjacent dots. These electrons have a tendency to possess antipodal destinations accordingly of their common electrostatic repulsion. Along these lines there exist two proportional enthusiastically negligible courses of action of the two electrons in the QCA cell, however no current directed out of the cell [9], [10] as appeared in Figure. 1.

1.1 QCA Logic Device –
These arrangements are indicated as cell polarization P=+1 and P=-1, these two cell polarization P= +1 which represents “1” and P= -1 represents “0”, binary information is encoded in the charge configuration of the QCA cell [11], [12]. Not at all like conventional logic circuits in which data is exchanged by electrical current, QCA works by the Columbic communication that associates the condition of one cell to the condition of its neighbours, which results as data change. One of the essential logic gates in QCA is the majority voter (MV).
The essential logic function in majority voter is shown in (1). MV can be acknowledged by just five QCA cells, as appeared in Figure 2(a) and 2(b) shown the logical block diagram of a majority gate.

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Figure 1. Quantum cellular automata

MV (A, B, C) = AB + BC + CA

Figure 2 (a) A QCA majority voter gate,(b) Basic block diagram of a QCA MV gate.

Logical AND (Fig. 3 (a)) and OR (Fig. 3 (b)) function can be implemented from the majority voter by fixing one input (control input) permanently to a 0 or 1.

Figure 3(a) QCA AND gate, (b) QCA OR gate

The inverter is another one basic gate in QCA. The interconnected fabric bus is shown in Figure 4.

Figure 4. (a) 9 cell QCA inverter gate, (b) 2cell QCA inverter
A few favourable circumstances can get utilizing QCA technology as is it “edge driven” means information is conveyed to an edge of a QCA block, that is assessed and yield at another edge. This moreover implies that no electrical cables need be steered inside. QCA frameworks ought to be low power, in light of the fact that there is no current flowing. Sufficiently just vitality needs to add to lift the electrons from their ground states. The required space for a circuit is little as in light of the way that the extent of QCA cells are uncommonly little [11-13].

1.2 QCA Wire—
QCA wire is a heap of interconnecting cells that are utilized to exchange polarization state. QCA wire can be comprised of 45° cells or 90° cells appeared in figure 5 respectively. The formal arrangement of QCA cells designs a binary wire. For the electrostatic interchanges between the cells the signal propagates from one end then onto the next. For a 45° QCA wire the engendering of the signal must be exchanged between the two polarizations [13]. A simple, 45 and 90 degree -cell QCA wire is shown in Figure 5.

![QCA Wire Diagram](image)

Figure 5. QCA (a) 45° wire (b) 90° wire.

1.3 QCA Clocking—
The clocking about QCA [11-16] can make finished by controlling the potential barriers between adjacent quantum-dots. Potential obstructions between contiguous quantum-dots. When the Possibility will be low the electron wave capacities turn into delocalized resulting is no positive cell polarization. Raising the potential barrier decreases the tunnelling rate, and thus, those electrons bring to localize. As the electrons localize, the cell gains a definite polarization. When the potential barrier has reached its peak point, the cell is said to be latched. Latched units go about as virtual. This enables not difficult pipelining about QCA circuits. It has been demonstrated that four timing zones every zones Pi / 2 degrees out from claiming stage is every last bit that is required by any QCA circuit as shown in figure 6[12,17,18].

![QCA Clocking Diagram](image)

Figure 6. Standard QCA Clocking Scheme

1.4 Advantages of QCA—
This technology has many advantages.
- It is edge driven, meaning an input is brought to an edge of a QCA block; it is evaluated and output at another edge. This also means that no power lines need be routed internally.
• The second advantage is that QCA based systems have very less hunger for power, because there is no current owing across. Only feeble energy is required to add to lift the electrons from their ground states.
• Finally, QCA cells are very small leading to space efficient circuitry developed out of them [19].

2. PROPOSED ALGORITHM
2.1 Proposed work –
In this study we implement a QCA design for realization of all gates using simple cellular-dot automata. The novelty of this gate besides parameter like delay, number of cell count, majority gate and area is minimal in comparison to most other designs. An encoder is a combinational rationale circuit that basically plays out a “turn around” of decoder capacities. An encoder acknowledges a dynamic level on one of its data sources, representing digit, for example, a decimal or octal digits, and changes over it to a coded yield, for example, BCD or binary. Attempt is taken to design 8x3 Encoder. The Encoder converts $2^n$ input lines into $n$ output lines. In this study in figure 7(a) and table 1 mentioned the circuit diagram as well as truth table for 8X3 encoder.

Table 1 Truth Table of 8x3 Encoder

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
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<tbody>
<tr>
<td>D_7</td>
<td>D_6</td>
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<td>0</td>
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<td>x</td>
<td>x</td>
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X=Don’t care

3. SIMULATION
For the proposed circuit format and usefulness checking, a reenactment apparatus for QCA circuits QCA Designer form 2.0.3, is utilized. The accompanying parameters are utilized for a bit able estimation: cell size=18 nm, clock high = 9.800000e-022 J, clock low=3.800000e-023 J, Dot diameter= 5 nm. The vast majority of the specified parameters are default values in QCA Designer. Fig 5 and 6 demonstrate circuit design and recreation consequences of proposed encoders. The simulated circuit layout of 8X3 encoder figure 8 to 9 respectively.
4. CONCLUSION

Our proposed procedure is a productive way that extraordinarily less no of cells, zone, and delay in signal engendering from the input to output. By this system, we can go for planning complex encoders. This system is exceptionally easy to actualize too. This QCA innovation is what's to come nanotechnology and distinctive established models can be supplanted by this QCA logic and this will turn out to be a great deal more proficient and less complex than its classical counterpart. This article represents the design, implementation and simulation 8x3 Encoder in a single circuit using quantum-dot cellular automata. This design is efficient in terms of cell count, area. It takes a cell count of 196 objects and an area of 0.30 um². Moreover considering the less numbers of cell count, area and power consumption.

5. REFERENCES