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The Design of Novel XORGATE

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ABSTRACT: Quantum Dot Cellular Automata (QCA) is the latest emerging technology. This technology is coming as a successful alternativetoCMOS(ComplementaryMetalOxideSemiconductor)technology.Nowadaysinthistechnicalera,weareusedtogadgets.Thebestpartof the technical platform is considered according to its power consumption or power dissipation parameter. In this context, QCA has proveditself the best alternative to CMOS. The Digital Logic Circuits are mainly designed QCA. These circuits consume very low power. This is themain key issue of the CMOS platform which is resolved by QCA. There are some best features of QCA that are attracting theattention of lotsof researchers. The QCA is used for nanoscale devices. This platform is known forultra-low power consumption, high packing density, andHigh-Speed small size. The Basic circuitswhich act as a fundamental platform are inverter and majority Gate. The design proposed is aparitygenerator and parity checker circuit. These circuits are used in nano communication forerror detection and correctioninthemessage.

KEYWORDS:QUANTUM-DOT-CELLULARAUTOMATA,QCA,NANOTECHNOLOGY

I. INTRODUCTION

How can we fastly connect with a new topic of technologyresearch? Well; it depends on our technical senses that howwe creatively carve out the best possible, positive aspects. Itis well understood that the development of any technology isbased on the applications and users. The CMOS platform isbasedontransistors.Itisatypeofmetaloxidesemiconductor field-effect transistor fabrication process. Ituses IC chips to construct analog circuits. This platform hasbeen the heart of the technical era since the 1960s, after thatlots of researchers have worked bitterly on this platform. TheCMOS(complementarymetal-oxide-semiconductor)hasalso been a part of lots of technical issues, due to its circuitrycomponents.

The QCAis one of the most promising technology for nanowork. It has the potential to replace CMOS (ComplementaryMetal Oxide Semiconductor) technology. The production ofchips using CMOS technology is scaling down nowadays.The QCA is transistor-less technology and is purely based onthe electron energy. The most interesting quality of QCA isextremelylowpowerdissipationandconsumption.TheinformationflowsinQCAwithoutanyflowofcurrent.

The important features of QCA are
1.Extremelylowpowerconsumption
2. HighDevicepackingdensity.
3. HighspeedintheorderofTHz
4. EnablerealizationofmoreDensecircuitswithswitchingspeed

The common computing modules are designed like adders,subtractors,multipliers,multiplexers.Thecommoncomputingmodulesaredesignedlikeadders,subtractors,multipliers,multiplexers. The QCA(Quantum Dot Cellular Automata) is coming as acomplete replacement of transistor-based circuits. This is duetoitsoutstandingfeaturesthatareultra-lowpowerconsumption, less cell density. The circuit designing in thisplatformisveryeasyandeasilyaccessibletogenerateoutputs, from which we can understand that the design isworking or not. It is highly scaled, uses binary information,less area, the e-waste is also very less. Due to its appealingseveral workers have been experienced the QCA to be, thebestplatformfordesigningdigitalcircuits..

II. BACKGROUNDOF QCA

The QCA (Quantum Dot Cellular Automata)Technologywas come into light in 1993. The fundamental unit of thequantum-

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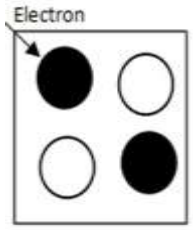
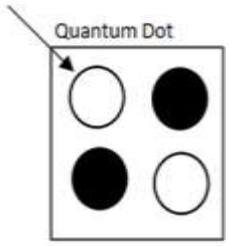
DotCellularAutomata(QCA)technologyisquantumcells .Quantumcells are thefundamentalunitofthistechnology.Wecantermthisnewtechnologyasatransistorlesstechnology.Duetoitsmodernwayoffunctioningthisplatformishighlighted foritsultralowpowerconsumption. The otherpoints forthis platform tobecomecenterofattractionisitshighspeedthatisinterahertz and high packing density. This technology is basedon Quantum cells. It is square, contains four dots and twoelectrons. The electrons have coulombic interactions betweenthem. The electrons occupy dots that are present on diametricsides.InCMOS(ComplementaryMetalOxideSemiconductor),thevoltagelevelsareusedforbinarycomputations. WhereasinQCA the location of the electronis inside the cell. The Binary computation is based on '0' and'1'. In QCA the cell polarization is used to represent '1' and'0'.Thefigureisshownbelow:



P = '-1'
BINARY '0'



P = '+1'
BINARY '1'

QCA cell uses specific polarization. This polarization dependson the electron's configuration. The particles or electrons tunnelbetween the dots mechanically. The electrons tunnel betweenthe dots. This tunneling effect is responsible for the switchingstates.Theswitchingstateis carriedoutbytheelectrons. TheinformationintheQCAcelltravelduetocoulombic interaction. The information exchange between the cells. Theinput cells after getting the required input start working; bydriving the neighboring cells.So this coulombic interactionbetweentheelectronsforcestheinputcellto aspecificpolarization. Thefigureshownbelowisabouttwodifferenttypesofpolarizationof QCAcells.

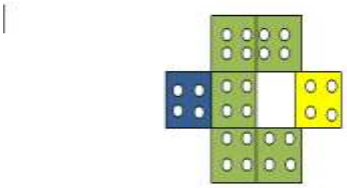


Figure (1): INVERTER GATE

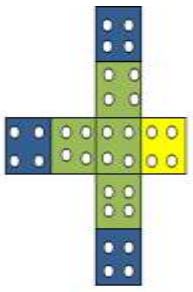


Figure (2): MAJORITY GATE

CLOCKING

The clock signal is used to control the flow of data and input.There are several reasons for the use of clocking in the QCAcircuit.

1. Theclocksignalcontrolsthedirectionoftheflowof informationfrominputtooutputcell.
2. Theclocksignalisusedtocontrolthetimingof QCAcircuits.The timinginQCAcircuitscontrolledisofquickswitching and quick relaxation. The reason is that the clockedcellrelaxes fasterthanthecells whicharenotclocked.
3. The use of too many clockedQCAcells createsa KINKstate.
4. Theclockingcreatespipelines.TheQCA(QuantumDotCellularAutomata)circuitsplitsintomultiplespecificzones.
5. Thesezonesareclockedwithmultipleclocksignals.Bydoing this the issue of KINK state is handled.The proposedXORGATE designsof

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different cellsand their output areshown below. The cells are reduced according to the variationsoftheiroutput.

WIRECROSSING

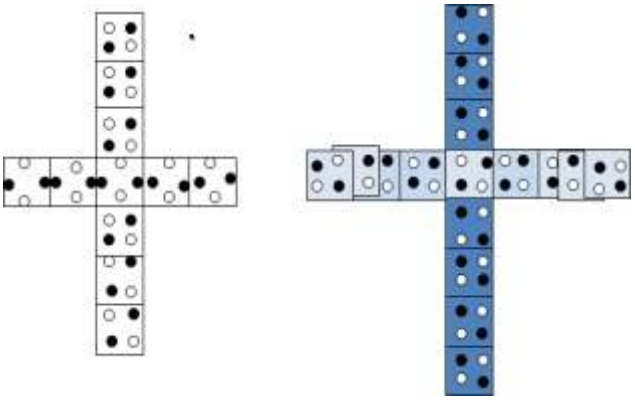
The wire crossing in QCA is a technique that allows the wire ofQCA cells composed of one type to pass through the wire ofQCAcellofanother typeperpendicularly.TheWireCrossing

1. COPLANARCROSSING

This method uses two types of QCA wires. Both wires areperpendicular to eachother. The cells used inthe wires areof two types. One of the wires has rotating type cells and theother wire has non-rotating type cells.This type of crossingis easily affected in the manufacturing process. This is thedisadvantageofcoplanarcrossing.

2. MULTI-PLANARCROSSING

This is the second type of strategy of wire crossing. In thisstrategy, one layer is crossed to another. There is enoughdistancebetweentwowires.Thereisenoughdistancebetween two wires. Due to this distance, the leakage of thesignal is prevented. The space between two wires creates wyto stack the cells. Multiple active QCA layers implement ontop of each other. The third type of wire crossing is logicalwirecrossing.



PARITYGENERATORCIRCUIT

The parity generator circuit proposed in the paper is based onXOR GATE. The XOR gate is a logic gate that gives outputfor an odd number of 1's input. The parity generator circuit isalsoknownasanerrordetectingcircuit.Theerrorthatoccurs in the transmitted data, is checked by matching thetransmitteddatawiththeoriginaldata.

ODDPARITYGENERATORCIRCUIT

The odd parity generator circuit is used to check the countednumberof 1's inthe transmitted data isoddor not. Thetransmitted data has aneven numberof 1,thenthe sumofthe binary numbers is zero. Now to correct this error 1 isadded as a parity bit to make the sum one. As we know thesumofbitsintransmitteddataisoneinanoddparitygenerator.

EVENPARITYGENERATORCIRCUIT

Theevenparitygeneratorcircuitisusedtocheckthecountednumberofi'sinthetransmitteddataisevenornot.Thetransmitteddatahasanoddnumberof,thenthesumofthebinarynumbersisone.Then,oneisaddedasaparitybittomakethesumzero.

As we know that the sum of bits in transmitted data is zero inanevenparitygenerator.

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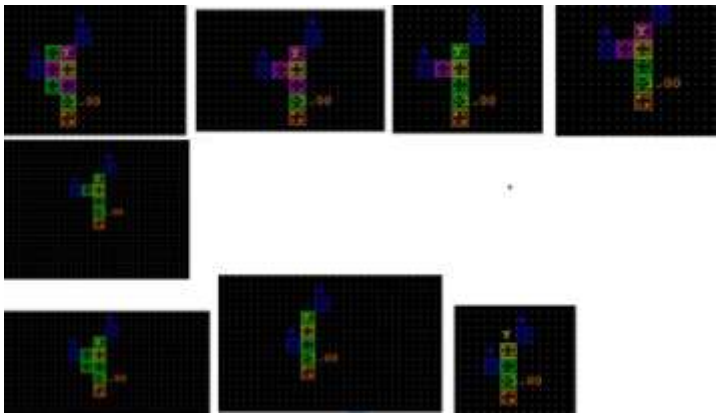
inQCAcellscanbedonebyusingtwodifferenttypesofo rientations of QCA wire. Both QCA wires are at 45 degrees toeach other. The coulombic interactions between the dots are thesame in both types of cells.The crossing point of different wiretypes produces no polarization. Therefore the signals on both thewires arepreserved.
TherearemethodstohandlewirecrossinginQCA.

UPDATEDWORKDONETILLNOW
AwidespreadstudyhasbeendoneinthiscontexttoachieveXORDesigns.Theauthorshavestudieddeeplythedesignsofthe exclusive-OR gate. The comparison table below shows theworkdoneinthiscontext.
TheproposedXORGATEdeignsofdifferentcells,andtheiroutputs areshownbelow.

DESIGNSOFXORGATE



OUTPUTSOFTHEABOVESHOWNDESIGN

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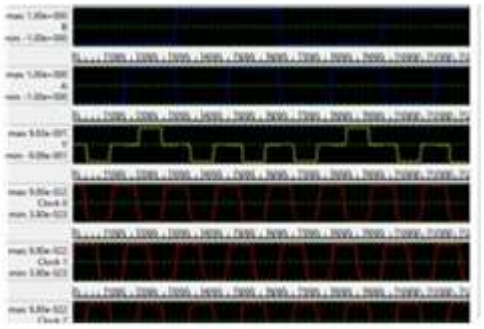

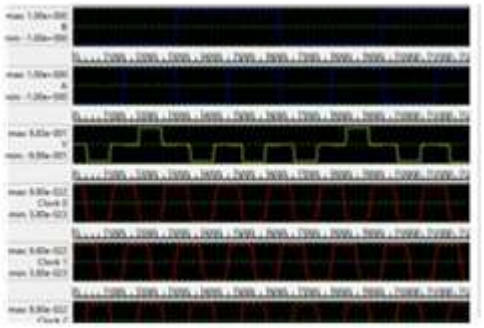

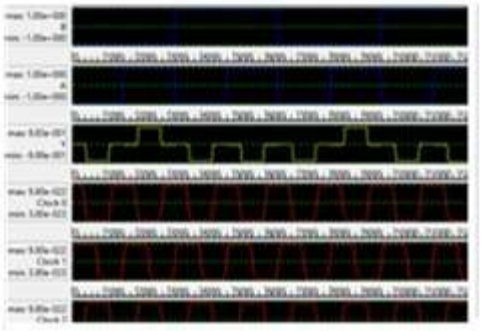

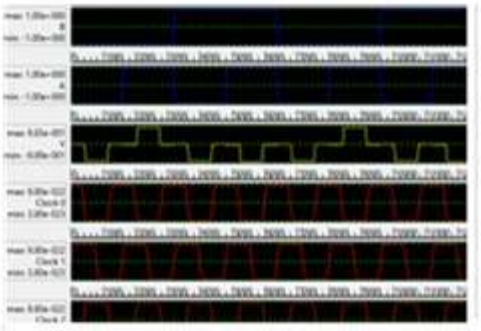

PROPOSEDXOR GATE DESIGNS OF 6 CELLS

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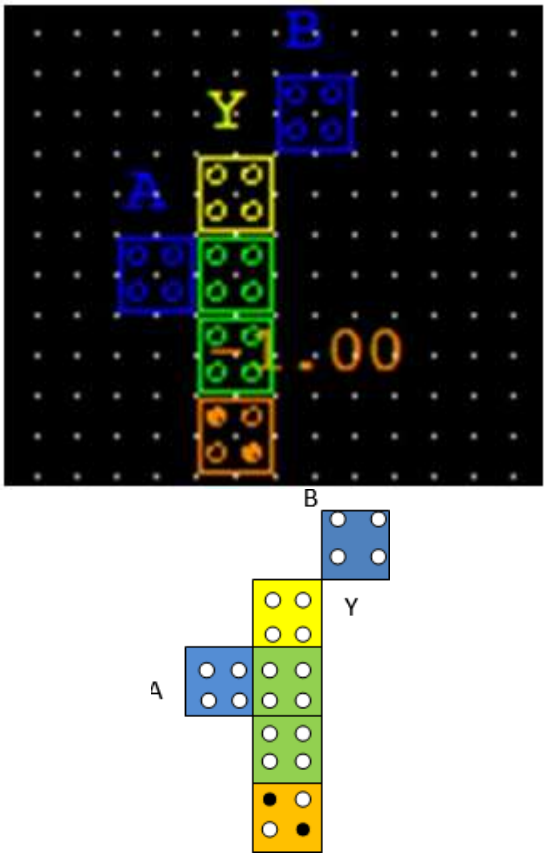

COMPARISONTABLE

Circuit	Area(micrometersquare)	Cellcount	Clock	Crossover
XOR1	0.09	60	1.5	coplanar
XOR2	0.08	54	1.5	coplanar
XOR3	0.06	67	1.25	coplanar
XOR4	0.03	37	1	NotRequired
XOR5	0.0015	10	3	NotRequired
XOR6	0.0135	9	0	NotRequired
XOR7	0.0120	8	0,1,2,3	NotRequired
XOR8	0.0105	7	0	NotRequired

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Proposedcircuit	0.090	6	0	NotRequired

III. CONCLUSION AND FUTURE SCOPE OF THE QCA TECHNOLOGY BASED ON THE COMPARISON TABLE

TheQCA(QUANTUMDOTCELLULARAUTOMATA) technology is the latest upcoming technology which is transistorlessandbasedontheenergyoftheelectron.Thecircuitdesigned using this platform is of ultra-low power consumption.This is the reason it is proved as a new sunrise in technology.The CMOS despite a lot of drawbacks but it struggled a lot inmeeting the interests of the researchers and proved best till nowupholdingdrawbacks

The future of the technology can be seen secure on this platformas it is of ultra-low power consumption and due to transistor lesstechnology so it is cheap to design and nano works can be donesafelyandefficientlywithlesse-wastage.

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