National Journal of Research in Technology & Engineering

Evolution & Applications of Nano Computing

Mitesh Bargadiya

Assistant Professor, Information Technology Department Swami Vivekanand College of Engineering Indore (M.P.) INDIA miteshbargadiya@svceindore.ac.in

Abstract—- Nano as the name represents something is to be smaller than their original size with the sufficient magnitude and power. The nano is define as the one billionth part of the one meter, it is the prefix used in the metric system of measurement that indicates 10 to the negative power 9 (10 -9) or 0.000 000 001.Nano reduces the size of the component up to firm level, which is consider to be negligible as compared to their original size. Nanotechnology has the wide area; it replaces the physical devices with new atoms or molecular structure. Nanotechnology is the new approach for precise the size of the components and the elements with the new materials and the new nanoelement contain the property of used material with substainal quantity.First time Richard P. Feynman was introduced the principle of a scale known nanoscale, but it was not implemented at that time. If such any type of equipment or computer system is implemented then it requires millions of fold to accelerate the computational speed of the system. It provides the advantage that it consumes lower power than the traditional computer and increases the battery life and processing power. The faster computer will have the implementation in area of Optical computing, Quantum computing, Biocomputing, Nanofabrication and the Molecular computing. In future it provides more advance technology in the various sectors.

Keywords—Nano Computing, Optical Computing, Quantum Computing, Biocomputing, Nanofabrication and Molecular Computing

I. INTRODUCTION (HEADING 1)

In the today's modern age computer system is the indispensable part of the technology. Every field has the significant use of the computer, without computer it is impossible to imagine the present scenario. As the time is going on the size of the component used in the electronics and information technology is precise, this all done through the nanotechnology. Nanotechnology is defined as that it is the fabrication of devices with the atoms or molecules, which combine the characteristics of different material in the newly constructed nanoelement with the substainal quantity. It produces the great impact on size of component. Those devices which having the size less than 100 nm is consist the product of nanotechnology. Nanotechnology has the wide taxonomy, nanocomputing is one of them. Nanocomputing is defined as, "The use of the discrete characteristics of structures on the scale of 100 nanometer or smaller to decode composite numerical or logical problems, or to achieve any of the tasks that we expect of contemporary computer" [1]. In 1959, the concept of the nanotechnology introduces by Richard P. Feynman, said a theory called "There's Plenty of Room at the Bottom." Feynman specified that it will feasible to construct the nano-scale and precisely operate atoms and molecules on that scale. It is potential in future to form the nano-scale mechanism through an arrangement of billions of units. His opinion about that this small machine shop would then eventually be able to create billions of smaller units [2]. And also projected that other various factor also significantly affect the nano-scale and especially when the scale being smaller and smaller then gravity will be negligible, while both Van Der Waals attraction and surface tension would become very important [3]. The four decades ago there is no relieve offered like as present i.e. that time mankind have no any devices such as personnel computer, World Wide Web, mobile phones, wireless phones, fax and answering machine, video player, cable TV, Compact and digital disk. These devices are not much popular like as present. At that time these devices have

very large size, not portable and they were costly, but the during last four decades scientists had begun to believe on smaller and smaller size of chips, they are the continuously taking straightforward and extraordinary action in this field. The creation and innovation in the nanotechnology was started. Nanocomputers have the power to run the internet over the communication network and information technology. Day by day make available fund in the nanotechnology could lead to advance such as molecular computers. Our computers get faster and faster and more and more reliable, we would have to make them smaller and smaller. This optimization will provide the nano wire, carbon nano tubes, in medical science it provides the nano medicine, diagnostics, drug delivery, in the area of chemistry it provides catalyst, filtration, in the area of energy it provides the efficient way of utilization of energy, reduce the consumption of energy, recycling the batteries, in the area of heavy industry it provides aerospace, infrastructure and construction, nanoparticles and steel, nanoparticles in glass, nanoparticles in coating, nanoparticles in fire protection and detection, vehicle manufacture, in the area of information technology and communication it provides memory, displays, novel semiconductor devices, novel optoelectronic devices, quantum computers etc.

II. APPLICATION OF NANOCOMUTING

Nanotechnology has begun the inception of new age of technology. Nanocomputing has the wide area for the applications, it used in the several field with impact on that field. Nanocomputing is in the initial stage but it having in short duration significant role in the every field. The nanocomputing replaces the traditional approach with the new approach of the nanoscale, which primarily concern with the size of the component. Nanocomputing have the following major field for application:-

- A. Biocomputing
- B. Molecular computing

- C. Nanofabrication
- D. Optical computing
- E. Quantum computing

A. Biocomputing: - Biocomputers utilize the structure of biologically referred molecules, like as DNA and Proteins, to achieve computational estimation concerning storing, retrieving and processing data. Biocomputer is expansion in new way of the nanobiotechnology. The term nanobiotechnology is identical to the bionanotechnology. The nanobiotechnology referred to as whichever form of technology that utilizes together nano-scale substance i.e. substances having typical size of 1-100 nanometers, as well as biologically form of substance [4]. The Biocomputer provides the flexibility to the scientist to program the molecules through commands and instruction inside the cells. Biocomputer will be revolutionize the natural theory of life, it may take new developing techniques which will be totally differ from the traditional methods and approach in the medical science. By this scientific approach can build the smart drugs, which will be very innovative discovery in the field of medicine. Smart drugs can easily detect the responsible active germs and other bacteria inside the human body and can take appropriate action at any time .By this approach minimized the material of medicine used for recovery from a disease and the also smart drug might be possible can predict the future effect on the human body. Biocomputer will be very smart device which provide any type of modification in the biological system directly through the programming cells. In medical science in future it is possible to change the sex through manipulating the genes by this technology. The Biocomputer can be programmed through the creature voice due to bio-system can function better than electrical equipment. The human brain of dead person can provide better memory banks than silicon-based chips from plant formed substance [5].

B. Molecular computing: - Molecular computing is a standard name for computational technique which uses single atoms or molecules as a means of explaining computational dilemma [6]. In molecular computing, the researchers are emphasis on the molecules of substance; it mainly uses DNA and also biological structure. Molecular computing has taxonomy but they are all in initial steps. In the future the molecular computers replaces the classical silicon based computers because silicon based computers are not provide the sufficient performance at present .The molecular computing will having the enormous storage capacity and operation on data such as storing , retrieving, transferring and fast processing on the data. DNA computing is primarily related to parallel computing in that it acquires benefit of the many diverse molecules of DNA to attempt several dissimilar potential at once [7].

Lets one kilogram of carbon contains 510^{25} atoms. If only 100 atoms to store one single bit or perform a computation operation. Using molecular parallelism, a molecular computing weighting a kilogram can process more than 10^{27} operation per second, more than a billion times faster than today's most excellent supercomputer, which executes at 10^{17} operation per second. Molecular computing has the

taxonomy for the computation they are differ in law of their execution. In DNA computing, DNA role as the software whereas enzymes role as the hardware. DNA computing is tremendously influential in its prospective. In Israel, researchers formed a DNA computer which can execute 330 trillion operations per second, more than 100,000 times faster than the rate of the fastest PC at the time, in 2002 [6]. DNA computing offers the much worse power utilization than classical silicon computers. DNA utilize the adenosine troposphere as fuel to permit or as a means to heat the strand to cause disassociation [8].In future it will possible to save a lot of energy, which is consume by the traditional computer at present time. It may be possible one CMOS battery can be used by system for couple of years. If the technology will growing at this speed the performance increased substantially too much fast nobody can expected that computation.

C. Nanofabrication: - In electronic industry day by day the equipments and devices size are minimizes, by the point of view of the cast effective and the portable. In today's IT and electronic market a number of gadgets are available, which was unimaginable in last few decades. The size of the components and elements, which is used in devices, is imaginably being smaller with the time at the nano scale. Due to creation of microscopic structure of components, now they are available at low cast in sufficient quantity.

The term nanofabrication is define as that it is the study and use of fabricating nanometer-scale formation, in the sense prototype with at least one creative aspect between the size of an entity atom and about 100 nm [9]. Nanofabrication technology is providing the fundamental principle for the massive fields such as medicine and pharmaceuticals, chip designing, diode, transistor, display screens and cellular-phone signal amplifier. By the nanofabrication, the size of transistor and diode became considerably very small that causes in a particular size of PCB holding the large amount of transistor , these was not possible in last few decades. The nano transistor consumes lower power as compare to traditional transistor and it gives the idea for inception of new invention.

D. Optical Computing: - Optical computing define as that it perform operation on the data, operation are such as storage, transmission, computation, encryption, compression etc using the photon of visible light or infrared beams and optical computing structured device is known as optical computer ,it also known as photonic computer [10]. Optical computing is the new way for efficient utilization of technology. In the computer system, electric current create the heat dissipation i.e. when the data is being process, that time for additional computation the power is required ,due to this causes heat is produced and it creates the harmful effect on the hardware. The photons produce less heat as compared to electron on a particular size. This advantage of photons provides a way to accelerate the computation speed of system. One more interesting fact about the photon that photons are not repel to each other but the electrons repel each other, that's reason in electron degrade the signal power.

Optical computing technology is being fundamentally developing in bifurcation. One approach is build the modern computer with the same architecture as at presently used but using optics that is electro optical hybrids. On the other hand second approach is build the completely advance new computer, which can perform all the computation in optical mode [11]. In such structure optical elements are used like optical switch, optical logic gates, optical memory, holographic storage, fiber optic cable, optical transrecievier and optical interconnection.

E. Quantum Computing: - A quantum computer is equipment for computation and processing that use the principle of quantum mechanical phenomenon, such as superposition and entanglement to execute functions on data. Quantum computer are separate from classical computers that supported by the transistor .The fundamental theory for quantum processing is that quantum characteristics can be used to specify data and execute processes on those data [12]. During the last few decades power of computer has increased at exponential rate, might be possible every two years double [13]. This expansion is subtly due to the optimization of the computer's most elementary component Transistor. Whenever the transistor minimized on a single chip the processing power of system is improved, but this minimization is increased at firm level quantum access below which transistors would close down to function. But these minimizations at the nano scale have a few hundred nanometers passes, when it supplementary minimized demean the computation and bother the operation. The information technology developing new alternative to transistor is quantum. It fundamentally based on the quantum effects instead of older technology. Quantum computing is the field where emphasis on the creating the vast storage capacity of the computer system through the principle of quantum theory.

In the traditional computer the memory is built by the bits, a small fundamental unit of memory or chunk of information. Every bit signifies the two diverse logical states true or false, or simply 0 or 1. Lets a register processed on three bits. Any register can store only one value at a time out of eight diverse arrangements. A quantum register processed on three qubits can be accumulating at any instant all eight combinations in a quantum superposition. An interesting fact about qubits is that a qubit is in the both state 0 and state 1 simultaneously. The storage capacity of system would be enlarged by accumulation of qubits i.e. N qubits can store 2N configuration simultaneously [14].

III. CONCLUSION

"What we didn't recognize then was that the integrated circuit would decrease the price tag of electric devices by a factor of a million to one, nothing had yet done that for something earlier than" by Jack Kilby [15]. The computer has limited computational speed, no any such revolution happen that cause accelerate speed since the elementary component transistor invented. During last sixty years in the technology tremendous change occurs, in previous time devices were very big in size, very expensive and not portable to anywhere ,but the time rapidly changed and now it is very flexible to customer to used devices at lower cost than previous time, this all of done through the introducing nanotechnology in such areas. Nanotechnology provides the solution of such compound problem in the efficient way with the computational and processing speed. For this the scientist and engineer are continuously inventing new approach with high precision. Nano structured based device taking out the evolutionary action in the technology, the Nanocomputers perform the task in similar way but having the computational speed much higher than traditional computer. The government and the trades are taking interested in the development of nanotechnology, for this they devote the billion's of dollar for explore the R&D of nanocomputing. In the future it provides the alternative for all the systems with the significant approach.

References

- Nanocomputing The Future of Computing , Vishal Sahni and Debabrata Goswami Tata McGraw Hill Education Private Limited ISBN-13: 978-07-024892-2 ISBN-10: 0-07-024892-3.
- [2] http://www.qi.fcen.uba.ar/materias/cqi/_recursos/Theresplent yofroomatthebottom.pdf.
- [3] http://www.zyvex.com/nanotech/ Feynman.html.
- [4] Wispelway, June. "Nanobiotechnology: The Integration of Nanoengineering and Biotechnology to the Benefit of Both." Society for Biological Engineering (Special Section): Nanobiotechnology.
- [5] http://uncylopedia.wikia.com/wiki/Biocomputers.
- [6] Wisegeek.com, Molecular computing, http://www.wisegraeek.com/molecularcomputing.htm.
- [7] David I. Lewin (2002). "DNA Computing", Computing in Science & Engineering 4 (3):5-8.doi:10.1109/5992998634.
- C.H. Bennett (1973). "Logical Reversal of Computation" IBM Journal of Research and Development17(6):525 32.doi:10.1147/rd.176.0525.
- [9] "Storex Disclosed Quantum Optical Lithography Technique", Press Release, Storage Newsletter.com, February 24th, 2012.
- [10] Feitelson, Dror G. (1988). "Optical Image and Signal Processing". Optical Computing: A Survey for Computer Scientists. Cambridge, ISBN 0-262-06112-0.
- [11] http://www.seminarprojects.com/Thread-opticalcomputing18053.
- [12] Gershenfeld, N., and Chuang, I. L. "Quantum Computing with Molecules," Scientific American, June, 1998.
- [13] ftp://download.intel.com/museum/Mooreslaw/Video-Transcipts/Excepts A conversation with Gorden Moore.pdf.
- [14] Simon, D.R. (1994). "On the power of quantum computation". Foundations of Computer Science, 1994 Proceedings., 35th Annual Symposium on: 116– 123.DOI:10.1109/SFCS.1994.365701. ISBN 0-8186-6580-7.
- [15] Nanocomputing The Future of Computing , Vishal Sahni and Debabrata Goswami Tata McGraw Hill Education Private Limited ISBN-13: 978-07-024892-2 ISBN-10:0-07-024892-3.