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Nanotechnology and Nano computing

Roshni Yadav[1], Prof.C.K.Dixit1, Sanjeev Kumar Trivedi[2]
[1]Department of Physics, Dr. Shakuntala Misra National Rehabilitation University, Lucknow-226017
[2]Department of Physics, Mumtaj P. G. College, Lucknow University, Lucknow-226007.

***Abstract:** Nanotechnology is one of the most advanced and diverse field including almost every branch of science and spreading in computer world. Nanocomputing is of the advanced integrated field of nanotechnology and computing solving the complicated nanoproblems and creating the most advanced computing components. Novel nano materials and nano devices are fabricated and operated by nanotechnology tools and methods. This research paper focusses on the incorporating work and results of the nano computing and its usefulness. Nano technology in computer science is termed as Nano computing, with its wide spreading branches including Electronic Nano computing, Mechanical Nano computing, Chemical Nano computing, Quantum Nano computing and others.*

***Keywords:** Nanotechnology; Nanocomputing; Electronic; Mechanical; Chemical; Quantum .*

I. INTRODUCTION

Nanotechnology in computer world holds an important place. Computers in the first generation to present showed a miniaturization of microprocessors and currently are in a process of being nano-metre scale [1]. Modern computer world is constructed from ancient technology resulting into the refined product from the bulk materials and thus this methodology is known as the bulk or top down technology. Feynman and Drexler introduced a new form of technology, which assembles individual atoms or molecules into a new finished product [2]. Top-down technology is still the most awaited technology for the construction of the mass assembled devices and thus nanotechnology is one of the factors of the increasing success in constructing bottom-up technology.

Moore's law also illustrated that CPU is doubled in performance every 18 months the feature size for device in a semiconductor chip is decreased by a factor of 2 every one and a half year. The number of transistors placed on a computer chip by the industry would double every 1.5 years cost of constructing a new Fabs will double every 3 years, and the simple solution of overcoming this problem is Nanotechnology.

National Science and technology council (USA) claim that "Nano-computing is an enabling technology that change the nature of almost every human made object in the next century"

II. LITERATURE REVIEW

Richard Feynman (1959), a famous Nobel Laureate physicist and father of nanotechnology, gave an inspiring talk entitled "There's Plenty of Room at the Bottom" describing the process in which scientists can easily examine and supervise individual atom and molecules. Later, the work of Drexler[2,3] also gave new perceptions regarding nanotechnology. Feynman and Drexler's thoughts have succeeded into real world inspiring and giving a new challenge to many researchers in physics, material science, chemistry, biology for future development. Microprocessor is an electronic component and is the Central processing unit on single integrated circuits of the computer controlling the memory, input/output devices, and overall operation in the computer.

In the mid 1990's, the term "nanoscale" referred to the circuit features less than 100 nm. Eventually, IC industry began to grow and advance to build the commercial devices at nanoscale. The first IC was invented by the Fairchild Semiconductor in 1959, INTEL 4004 first microprocessor of INTEL introduced in 1971 was a four-bit microprocessor and thus with the gradual improvement based on the Moore's law INTEL co-founder Gordon Moore, number of transistors per square inch in IC doubled every year leading to the current I5 and I7 efficient microprocessors. With advanced and efficient microprocessors, new nanotechnological world can be easily evaluated and thus the solutions of the complex and elaborative wave equations of composite atomic systems became a perceive and realizable objective.

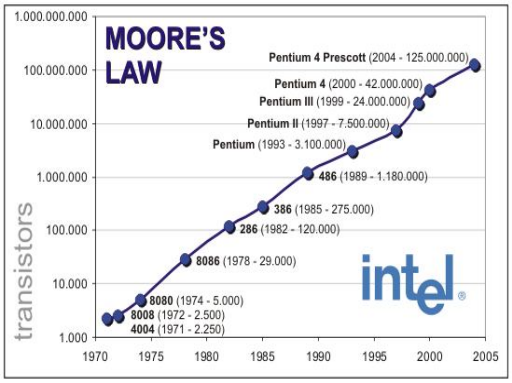

Fig 1: Moore's law prediction [4].

Martin Karplus, Michael Levitt, and AriehWarshel, a Nobel Laureate for premising the computer models incorporating the principles of classical/ Newtonian physics and quantum physics to clone the exquisite detail information of chemical processes. For the construction of the mathematical models that used the thermodynamic and chemical laws for the explanation of the ozone formation and decomposition in the atmosphere the three computational chemists, Paul Crutzen, Mario Molina and F. SherwoodRowland won the Chemistry Nobel in 1995 **[5]**.

III. NANOTECHNOLOGY LEADING TO NANOCOMPUTING

Nanotechnology has laid its path in nanocomputing leading towards the new precise and advanced solutions for a complex molecular or any other problems. Nanocomputing has helped the researchers by providing the new characterization techniques leading towards the structure determination of the nanomaterials and new optimization opportunities and thus according to its processing and determination qualities in different field of research it has been categorized in different streams of computing.

A. Electronic nanocomputing

is one of the main stream of the computing, as it is well discussed that the electronics has faced the drastic change from the first generation to the present generation leading to the more advanced technology. The main difference is that from first generation to present there is the variation of the physical scale, most of the transistors nowadays are compressed in single silicon chips with ever increasing storage capacity and processing power.

B. Chemical nanocomputing

is another stream of the computing storing and processing the information in chemical terms including the chemical structures and interactions. Computational chemists have also well received noble prize for their work and helping the manufacturers design high yielding and efficient processes and characterization techniques characterizing new compounds and materials. Computational chemistry is also known for the study of the elemental properties of the atoms, molecules and various chemical reactions employing thermodynamics and quantum.

Nanocomputing research incorporates the important aspect of molecular fabrication and electronic devices architectures that can avail the inherited electrical properties and thus it provides the successful determination of structures and their other properties including quantum dots, electronic structures and molecules. Quantum dots resembles to an artificial atoms and molecules, electrons residing can only be used to represent logic information vigorously.

C. Mechanical nanocomputing

is another fascinating computing field which focusses on the microscopic moving parts unlike electronic nanocomputing. Binary switches compute the ones and zeros leading towards the new driving techniques of the modern computers which are basically created due to the Gate, pillar, levers and pistons and thus the nano mechanical chips has a wide range of applications in different aspects of world.

Nanocomputing has incorporated every branch and proved its usefulness in almost every part of science, engineering and others. The basic fundamental idea behind the nanocomputing lies in the nanotechnology reaching every complex field and providing the

solution for every aspect and thus nanotechnology and nanocomputing are the two realms of the world that depends on each other for the successful and efficient output.

D. Chemical and biochemical nano-computers

are another significant computing stream that stores and process the information in the form of chemical structures and their interactions. Biochemical nano-computers are already apparent in the living world but due to its uncontrollable nature it has its major drawback

Nanotechnology has created an effective path in the computer world providing effective processing features, miniaturization from micro to nano obeying the moore's law and effective optimization features. A large number of small particles with complex structures can easily be detected to provide effective results. The fabrication and growth of the crystals, bottom up nanotechnology, fundamental properties can easily be considered by the joint innovative venture of the nanotechnology and computing.

IV. LIMITATIONS

Although nanocomputing is having a magnificent performance it also has some of its drawbacks to be overcome such as the electronic scientists need to change or develop new circuits to cope with nanocircuits while dealing with carbon nanotubes. The cooling procedure for the ultra-capacitors due to its high heat production has no restoration till now.

V. CONCLUSION

Nanotechnology and nanocomputing collectively have emerged as a most prominent field solving the complex problems in a short period and thus leading to more and more innovative research providing new technological advancement in every part of life. Nanocomputing has adopted the miniaturization fundamental from the nanotechnology and leading towards the stable and prominent work processes. In every part of nanotechnological world either electronic, mechanical or quantum computing has generated a more useful and easily available output for every complex problem in any part. Thus, we can say that nanotechnology and nanocomputing are depending on each other.

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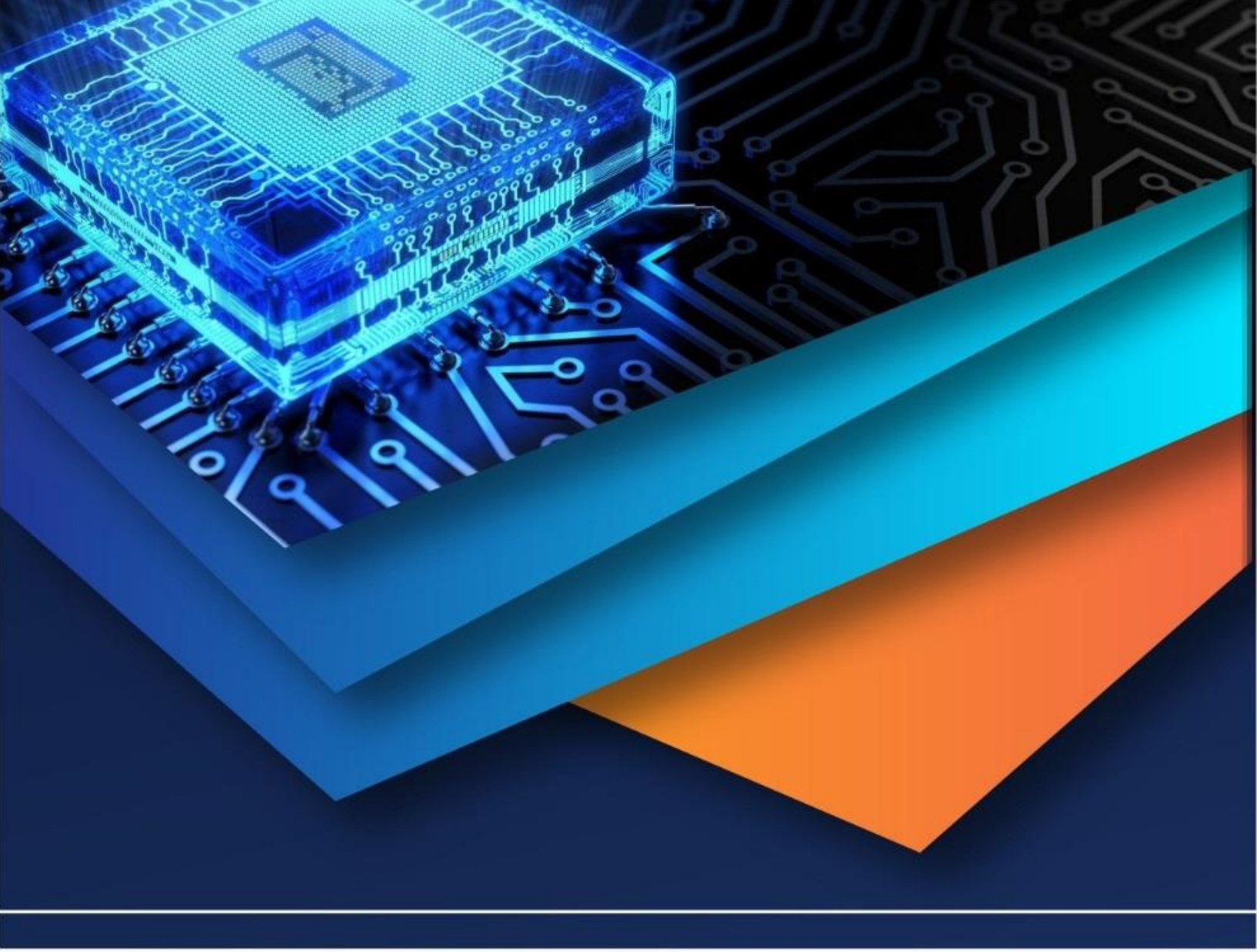

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