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Nano computing revolution and future prospects

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Abstract

There are several ways nanocomputers might be built, using mechanical, electronic, biochemical, or quantum technology. It is unlikely that nanocomputers will be made out of semiconductor transistors (Microelectronic components that are at the core of all modern electronic devices), as they seem to perform significantly less well when shrunk to sizes under 100 nanometers.The research results summarized here also suggest that many useful, yet strikingly different solutions may exist for tolerating defects and faults within nanocomputing systems. Also included in the survey are a number of software tools useful for quantifying the reliability of nanocomputing systems in the presence of defects and faults.

Keywords: Nano computing, electronic devices, technology

INTRODUCTION

Nanocomputer is the logical name for the computer smaller then the microcomputer, which is smaller than the minicomputer. (The minicomputer is called “mini” because it was a lot smaller than the original (mainframe) computers.) More technically, it is a computer whose fundamental part is no bigger than a few nanometers. For comparison, the smallest part of current state-of-the-art microprocessors measures 45 nm as of February 21, 2007. No commercially available computers that are named nanocomputers exist at this date, but the term is used in science and science fiction.

The history of computer technology has involved a sequence of changes from gears to relays to valves to transistors to integrated circuits and so on. Today’s techniques can fit logic gates and wires a fraction of a micron wide onto a silicon chip. Soon the parts will become smaller and smaller until they are made up of only a handful of atoms. At this point the laws of classical physics break down and the rules of quantum mechanics take over, so the new quantum technology must replace and/or supplement what we presently have. It will support an entirely new kind of computation with new algorithms based on quantum principles.

Presently our digital computers relay on bits, which, when charged, represent on, true, or 1.When not charged they become off, false, or 0. A register of 3 bits can represent at a given moment in time one of eight numbers (000, 001, 010, …… 111).In the quantum state, an atom(one bit) can be in two places at once according to the laws of quantum physics, so 3 atoms(quantum bits or qubits) can represent all eight numbers at any given time. So for x number of qubits, there can be 2^x numbers stored. (I will not go into the logic of all this or this paper would turn into a book!). parallel processing can take place on the 2^x input numbers, performing the same task that a classical computer would have to repeat 2^x input numbers, performing the same task that a classical computer would have to repeat 2^x times or use 2^xprocessors working in parallel. In other words a quantum computer offers an enormous gain in the use of computational resources such as time and memory. This becomes mind boggling when you think of what 32 qubits can accomplish.

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This all sounds like another purely technological process. Classical computers can do the same computations as quantum computers, only needing more time and more memory. The catch is that they need exponentially more time and memory to match the power of a quantum computer. An exponential increase is really fast, and available time and memory run out very quickly.

Nanocomputers have the potential to revolutionize the 21st century in the same way that the transistor and the internal led to the information age. Increased investments in nanotechnology could lead to breakthroughs such as molecular computers. Billions of very small and very fast (but cheap) computers networked together can fundamentally change the face of modern IT computing in corporation that today are using mighty mainframes servers. This miniaturization will also spawn a whole series of consumer-based computing products: computer clothes, smart furniture, and access to the internet that’s thousand times fasters than today’s fastest technology.

Nanocomputing describe computing that uses extremely small, or nanoscale, devices (one nanometer[nm] is one billionth of a meter). In 2001, state-of-the=art electronic devices could be as small as about 100 nm, which is about the same size as a virus. The Integrated circuits(IC) industry, however, looks to the future to determine the smallest electronic devices possible within the limits of computing technology.

Until the mid-1990s, the term”nanoscale” generally denoted circuit features smaller than 100 nm. As the IC industry started to build commercial devices at such size scales since the beginning of the 2000s, the term “nanocomputing” has been reserved for device features well below 50 nm to even the size of individual molecules, which are only a few nm. Scientists and engineers are only beginning to conceive new ways to approach computing using extremely small devices and individual molecules.

All computers must operate by basic physical processes. Contemporary digital computers use currents and voltages in tens of millions of complementary metal oxide semiconductor (CMOS) transistors covering a few square centimeters of silicon. If device dimensions could be scaled down by a factor of 10 or even 100, then circuit functionality would increase 100 to 10,000 times.

Future nanocomputers could be evolutionary, scaled-down versions of today's computers, working in essentially the same ways and with similar but nanoscale devices. Or they may be revolutionary, being based is aimed at learning the physical properties of very small structures and then determining how these can be used to perform some kind of computing functions.

Current nanocomputing research involves the study of very small electronic devices and molecules, their fabrication, and architectures that can benefit from their inherent electrical properties. Nanostructures that have been studied include semiconductor quantum dots, single electron structures, and various molecules. Very small particles of material confine electrons in ways that large ones do not, so that quantum mechanical nature of the electrons becomes important.

In addition to discovering new device on the nanoscale, it is critically important to device new ways interconnect these devices for useful applications. One potential architecture is called cellular neural networks (CNN) in which devices are connected to neighbors, and as inputs are provides at the edge, the interconnects cause a change in the devices to sweep like a wave across the array, providing an output at the other edge.

An extension of the CNN concept is that of quantum-dot cellular automata (QCA). This architecture uses arrangement of single electrons that communicate with each other by Coulomb repulsion over large arrays. The arrangement of electrons at the edges provides the computational output. The electron arrangements of QCA are controlled by an external clock and operate according to the rules of Boolean logic.

Another potential architecture is that of "crossbar switching" in which molecules are places the intersections of nanometers-scale wires. These molecules provide coupling between the wires and provide computing functionality.

In summary, nanocomputing technology has the potential for revolutionizing the way that computers are used. However, in order to achieve this goal, major progress in device technology, computer architectures, and IC processing must first be accomplished. It may take decades before revolutionary nanocomputing technology becomes commercially feasible.

The Potential for Nanotechnology

Contrary to popular belief, the marriage of chemistry, computing, and microscopic engineering known as nanotechnology is not a new phenomenon; scientists have been working on the possibilities for decades. Nanotechnology today is an emerging set of tools, techniques, and unique applications involving the structure and composition of materials on a nanoscale- that is, billionths of a meter. This research has the potential to usher in a golden era of self-replicating machinery and self-assembling consumer goods made from cheap raw atoms. The following list presents just a few of the potential applications of nanotechnology

- Expansions of mass-storage electronics to huge multi-terabit memory capacity, increasing by a thousand fold the memory storage per unit. Recently, IBM's research scientists announced a technique for transforming iron and a dash of platinum into the magnetic equivalent of gold: a nanoparticle that can hold a magnetic charge for as long as 10 years. This breakthrough could radically transform the computer disk-drive industry.
- Making materials and products from the bottom up; that is, by building them from individual atoms and molecules. Bottom-up manufacturing should require fewer materials and pollute less.
- Developing materials that are 10 times stronger then steel, but a fraction of the weight, forming all kinds of land, sea, air, and vehicles lighter and more fuel- efficient. Such nanomaterials are already being produced and integrated into products today.
- Improving the computing speed and efficiency of transistors and memory chips by factors of millions, making today's chips seem as slow as the dinosaur. Nanocomputers will eventually be very cheap and widespread. Supercomputers will be about the size of a sugar cube.
- Using gene and drug delivery to detect diseased cells; nanoagents will target organs in the human body, providing molecular repair and cell surgery.
- Removing the finest contaminants from water and air to promote a cleaner environment and potable water.

REFERENCES

[1] Beckett, P., Jennings, A.: Towards Nanocomputer Architecture. In Proc. of the 7th Asia-Pacific Computer Systems Architecture Conference, ACSAC 2002, Melbourne, Australia.

[2] K. E. Drexler, C. Peterson and G. Pergamit, 1991. Unbounding the Future: the Nanotechnology Revolution.

[3] Colvin, V. 2003. The Potential Environmental Impact of Engineered Nanoparticles. *Nature Biotechnol.*