Prediction of Future Computers Using State of the Art Developing Technologies

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Abstract

At first previous predictions about future of computers, such as Moore's law is analyzed. Then developments in basic science such as quantum physics, and spintronics, and also developments in technologies such as biology, nanoelectronics, photonics and nanophotonics, communications technologies, and medical engineering that are applicable in computers, are introduced. Then expected future goals are discussed: Reduction of costs and weight, increase of processing speed, increase of intelligence and integration with other systems.

Key words: Futures, Computer, Photonics

1. Introduction

Computers are inseparable part of human life nowadays and we can hardly find complex systems which no processor is employed in it. In this paper we tried to analyze technological developments in recent years which is not employed in computers.

One of the most famous predictions introduced in past, and is valid until now, is Moore's law. Moor which is one of the producers of Intel Corporation predicted that the number of transistors in a specified surface, approximately duplicated each two years. Producing 22 nanometer transistor with 3 gates, the Intel company are following the Moore's law. Moore believed that number of transistors are … of complexity, but today we should include other parameters such as processor technology [5,6].

2. Developments of basic sciences

Present computers are produced on basis of classic physics, and new developments in basic science has no an influence on computers. In this section, we introduce some developments that can change the future of computers.

2.1. Quantum Physics

Quantum physics is a branch of physics considering physics in microscopic scales. Quantum computers use quantum physics for processing, computations, and saving data. Last year (2011) group of scientists in Japan and Australia could transfer a complete set of quantum data. Quantum processors, quantum data processing, quantum memory, quantum bus, and quantum cognition are very common phrases in researches, which indicate that quantum computers are increasingly in development. Quantum computers can do some

processes very faster than common computers. A group of Australian researchers tell that first quantum computers will be presented about 5 to 10 years [7,8,12].

2.2. Spintronics

Spintronics (spin transport electronics) is a branch of science which uses spins and magnetic moments of electrons in solid state devices. This science is emerged in 1980's and today is completing. Using this knowledge, electron spins have the ability to apply for data processing. Also spintronics has applications in data storage devices (hard disc technology and magnetic RAM) and magnetic sensors [5, 14, 15].

3. Developments of engineering sciences

Biotechnology, nanoelectronics, photonics and nanophotonics, communications technologies and medical technologies are some of engineering sciences that their results and products may be applied in future computers.

3.1. Biotechnology

Natural computers use natural materials for computations. Artificial neural networks, evolutionary algorithms, DNA computer, molecular computer, cellular automata, swarm intelligence or collective intelligence, and membrane computing are some of research fields. Computational paradigms of these computers are extracted from natural phenomena such as self-replication structures. Genomic computers architecture is changeable, while architecture of traditional computers are fix and unchangeable. In genomic computers there is not any distinction between hardware and software. In genomic computers data transfer is made by molecules and ions. [5, 9, 13]

Synthetic biology is another research area that may lead to new products in computer world. Using results and products of genetic engineering, synthetic biology produce artificial organisms which are be able to live.

3.2. Nanoelectronics

Nanotechnology and especially nanoelectronics are manufacturing some products in laboratories. Products such as nanotransistors, nanotubes, and so on, lead to increase the density of transistors in a specific volume. So we will see some ICs in future, which are able to do more processes in lower space in a second.

3.3. Photonics and Nanophotonics

Photonics technology will maturate in future and introduce their products to computer industry. Optical bus is one of these products, which is substitution of electrical bus and can increase data transmission rate to tera bits per second. Electrical interferences and time delay due to broadening of electrical pulses are essential limits of clock frequency of electrical bus.

Printed boards with metal strips for electrical connection of circuits are substituted with optical boards having transparent routs for optical connection between IC's. On the other hand, electrical signals are converted to optical signals. This bus can resolve bandwidth problems in connections between IC's. Inside IC's there are routes for transmission of optical signals.

Nowadays optical products, have the ability to transmit data via optical fiber, but for processing these signals must be converted to electrical signals and after that reconverted to optical signals. Conversion of electrical signals to optical signals and vice versa may lead to decrease transmission rate of data. Recent photonic and nanophotonic products can do optically some limited processings (like optical correlator). If there is possible to

construct a processor which does all processings optically, the processing speed will increased extremely, and due to extra-large bandwidth of optical signals, the problem of bandwidth is resolved. [5, 10]
Optical processings which are results of optical engineering in nanotechnology, photonics, and nanophotonics areas, may lead to construction of optical processors, which can do complex and heavy computations (which need several billion operations per second), with lower operations, in a small fraction of a second. For example a convex lens can convert an optical signal to its Fourier transform. The speed of operation is the time of passing signal from lens [2]. But if we convert that signal to electrical one, and convert it to it's FFT, we need some seconds which depends on frequency of signal and its bandwidth.

3.4. Communications technologies
Although MMIC[1] technology has emerged few decades [4], it hasn't applied in computer systems. The need for higher speed processing and volume reduction of processors are two reasons that high frequency devices may be applied in computers, in such a way that the cost of high frequency boards is reduced.

3.5. Medical technologies
The idea of using brain waves for transferring instructions to computers was in introduced in VMworld conference. So it may be possible in future that we control a computer or a machine only by using brain waves. The brain computer interface (BCI) is following for years, and it seems to see commercial products of these researches in future.

4. Today and future applications of computers
Today we see computers in various fields and extensive types of systems. Some of them are:

1. In factories and industries in various systems for: industrial control of production process, testing and R&D, automation of official works.
2. In economy for: economic planning, extraction and analysis of statistical data, banking system, electronic commerce, and so on.
3. In education field and education systems helps students, teachers, professors, and researchers. They are use computers as an essential tool. Other devices such as projectors, intelligent boards, and so on, use digital processors.
4. In military systems and military products, it is inevitable to use powerful computers and high speed processors. We see that intelligence in military products is increasing. This intelligence indicates that computers are massively applied.
5. Security products, such as softwares, firmwares, hardwares, supervising and surveillance cameras, intelligent doors, and other security products use computers as a main part of the product.
6. Vehicles, such as cars, ships, airplanes, metros, and trains use computers for controlling motor and other required controls.
7. Communication devices such as Internet, telephone, mobile phone, devices using Bluetooth, wimax, and so on use processors for controlling communication.
8. Multimedia systems such as TV, radio, recording systems, home cinema, and so on use processors in their structure.

[1]Microwave Monolithic Integrated Circuits

9. In the field of medicine and remedy, computers and digital processors are essential part of diagnostic and measurement systems (such as imaging systems, blood pressure measurer, ECG of heart and brain, …) remedial systems such as tools and systems for operations, hospital coaches, surgery laser systems, …).

As a brief we can say that computers and digital processors are applied in almost all fields of our life, and we that their applications are increasing.
Professor Carolux predicted that: all devices and tools will be computational tools. There will not be a system named computer, but transparent computational devices are substituted. All things will be computers but we don't sense the presence of computer, such as a timer in a refrigerator that does its work and we don't sense that there is a computational device. Everything in everywhere is a computer. Future computers are interacting with real world. [11]
Modeling sentiments in computers and intelligent devices, will lead to friendly and kindly robots that can estimate sentiments of peoples and control them. [11]

5. Future goals

We can lead to these outcomes for future of computers: more intelligence, reduction of weight and volume, lower energy and change the type of energy, and integration with other systems.

5.1. More intelligence

Ray Kurzweil, provident scientist forecasted in 2011 that it is possible to reverse engineering of human brain. This means that it will be possible in future to do all computational and processing capabilities of brain with artificial intelligence and computer systems. Dr. Peter Denning, believes that according to Moore's law that the computational power will be doubled each two years, we can say that by 2030 the technology will develop such that computational power of human brain has the volume smaller than human brain. Some scientists forecast that artificial intelligence will receive to a point that computer thinks for itself [1].
The goal is catching information, so the computer in the age of information technology, is only a device for catching the information, or processing and mining the data for extraction of information. So the computers seem to more user friendly.

5.2. Lower Weight and Volume

Current approach of products induces this idea that we will have a very small computer (e.g. a coin) and receive its energy from nature.

5.3. Energy

The required energy of computers can be received from heat of human body or environment, sun light, acoustic environment noise, mechanical and acoustic vibrations, and so on. Also reduction of physical volume will lead to reduction of consuming energy. So we can expect that there will be a computer like a watch that receives its energy from mobility of hand, or from environment. So there will not be the problem of empty battery, and electrical charger is not meaning for electronic devices. Today fuel cells producing oxygen and batteries made from plants are in development.

5.4. Integration with other systems

Emersion of softwares and options which are widespread for tablets, laptops, and mobile phones inspire having a computer in future that is very small and:

- Do all required computations and operations, as a computer.
- Is connected to various data networks such as internet, intranet, databases, and support all needed data, information, firmware, software, hardware, and other virtual world products.
- As a communication device, support all communication needs of user such as massage, audio, image, touch, smell, and taste connections.
- As a tool support all needs of user such as: scanner, printer, fax, barometer, altimeter, thermometer, moisture measurer, navigation system, compass, direction finder, balance, medical tester such as sugar of blood, blood pressure, echocardiogram, and analysis of the results.
- As an electronic card, connects to banking network, and do all economical activities of user.
- Act as an identification system, like national card, student card, identification card, or membership card for a company, office, university, and so on.

It is obvious that implementation of some above ideas have security, legal, and psychological challenges, which seem to be resolved with technology development.

8. Conclusion

Solid state technology is following Moor's law. But other parameters has increased speed, performance and capabilities of computers. Developments in science and engineering will lead to products such as: quantum processors, quantum buses, quantum memories, molecular memories, molecular processors, and optical fiber data bus, which extremely increase processing speed, reduce required volume for saving data, increase information transmission, and reduction of weight and volume.

Products of brain computer interface products, lead to simplification of computers which will be more user friendly. Some of goals which can be imagine for computers in future are: increase of intelligence, reduction of weight and volume, changing type of consuming energy, and integration with other systems.

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