Nano-Robotics – "A Hope for Future"

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***Abstract*— A nano-robot is a tiny machine designed to perform a specific task or tasks repeatedly and with precisions at nanoscale dimensions, that is, dimensions of a few nanometers or less, where 1nm = 10^{-9} meter. Nano-robotics is a synchronization of mechanical , electrical and computer science branch. Nanoscale systems can operate much faster than their counterparts because displacements are smaller, this allows mechanical and electrical events to occur in less time. Nano-robots might function at the atomic or molecular level to build devices, machines or circuits, a process known as molecular manufacturing. Nano-robotics technology can change entire industry and society. Here we propose theoretical survey of nano-robotics technology.**

***Index Terms*— nano-robot, nanoscale, nanometers**

I. INTRODUCTION

A robot is a mechanical or virtual artificial agent, basically a man-machine interface that is guided by a computer program or electroniccircuitry.

Robotics is the branch of technology that deals with the design, construction, operation, and application of robots, as well as computer systems for their control, sensory feedback, and information processing. Today, robotics is a rapidly growing field, as technological advances continue, research, design, and building new robots serve various practical purposes, whether domestically or militarily.Nanorobotics is the technology of creating machines or robots at or close to the scale of a nanometre (10^{-9}metres).More specifically, nanorobotics refers to the still largely theoretical nanotechnology engineering discipline of designing and building nanorobots.Nanorobots (nanobots or nanoids) are constructed of nanoscale or molecular components.As no artificial non-biological nanorobots have so far been created, they remain a hypothetical concept at this time.Another definition sometimes used is a robot which allows precision interactions with nanoscale objects, or can manipulate with nanoscale resolution.Following this definition even a large apparatus such as an atomic force microscope can be considered a nanorobotic instrument when configured to perform nanomanipulation.

Also, macroscale robots or microrobots which can move with nanoscale precision can also be considered nanorobots.

II. ORIGINS OF "ROBOT" AND "ROBOTICS"

The word "robot" conjures up a variety of images, from R2D2 and C3PO of Star Wars fame; to human-like machines that exist to serve their creators (perhaps in the form of the cooking and cleaning Rosie in the popular cartoon series theJetsons*);* to the Rover Sojourner, which explored the Martian landscape as part of the Mars Pathfinder mission. Some people may alternatively perceive robots as dangerous technological ventures that will someday lead to the demise of the human race, either by outsmarting or outmuscling us and taking over the world, or by turning us into completely technology-dependent beings who passively sit by and program robots to do all of our work. In fact, the first use of the word "robot" occurred in a play about mechanical men that are built to work on factory assembly lines and that rebel against their human masters. These machines in R.U.R. (Rossum's Universal Robots), written by Czech playwright Karl Capek in 1921, got their name from the Czech word for slave.

The word "robotics" was also coined by a writer. Russian-born American science-fiction writer Isaac Asimov first used the word in 1942 in his short story "Runabout." Asimov had a much brighter and more optimistic opinion of the robot's role in human society than did Capek. He generally characterized the robots in his short stories as helpful servants of man and viewed robots as "a better, cleaner race." Asimov also proposed three "Laws of Robotics" that his robots, as well as sci-fi robotic characters of many other stories, followed:

Law One

A robot may not injure a human being or, through inaction, allow a human being to come to harm.

Law Two

A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

Law Three

A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

III. NANO-TECHNOLOGY

Just as the industrial revolution ushered our way into the world we know today, nanotechnology will soon change our world beyond comprehension. It is predicted to cure all current types of illness, even aging. It will lead to massive improvements in battery and solar power, ending our dependence on the Earth's gas, coal, and oil resources. Quantum computing will create computers that are billions of times more powerful than the ones we have today. Many many more innovative examples exist; literally everything you know will be dramatically enhanced by nanotechnology.

Nanotechnology is sometimes referred to as a general-purpose technology. That's because in its advanced form it will have significant impact on almost all industries and all areas of society. It will offer better built, longer lasting, cleaner, safer, and smarter products for the home, for

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communications, for medicine, for transportation, for agriculture, and for industry in general. Like electricity or computers before it, nanotech will offer greatly improved efficiency in almost every facet of life. But as a general-purpose technology, it will be dual-use, meaning it will have many commercial uses and it also will have many military uses—making far more powerful weapons and tools of surveillance. Thus it represents not only wonderful benefits for humanity, but also gave risks.A key understanding of nanotechnology is that it offers not just better products, but a vastly improved manufacturing process. A computer can make copies of data files—essentially as many copies as you want at little or no cost. It may be only a matter of time until the building of products becomes as cheap as the copying of files. That's the real meaning of nanotechnology, and why it is sometimes seen as "the next industrial revolution."

A. NANO ROBOTICS THEORY

According to Richard Feynman, it was his former graduate student and collaborator Albert Hibbswho originally suggested to him (circa 1959) the idea of a medical use for Feynman's theoretical micromachines .Hibbs suggested that certain repair machines might one day be reduced in size to the point that it would, in theory, be possible to (as Feynman put it) "swallow the doctor". The idea was incorporated into Feynman's 1959 essay There's Plenty of Room at the Bottom.

Since nanorobots would be microscopic in size, it would probably be necessary for very large numbers of them to work together to perform microscopic and macroscopic tasks. These nanorobot swarms, both those incapable of replication (as in utility fog) and those capable of unconstrained replication in the natural environment, are found in many science fiction stories, such as theBorognanoprobes in Star Trek and The Outer Limits episode The New Breed.

Some proponents of nanorobotics, in reaction to the grey goo scenarios that they earlier helped to propagate, hold the view that nanorobots capable of replication outside of a restricted factory environment do not form a necessary part of a purported productive nanotechnology, and that the process of self-replication, if it were ever to be developed, could be made inherently safe. They further assert that their current plans for developing and using molecular manufacturing do not in fact include free-foraging replicators.

A practical approach with advanced computer aided manufacturing analysis is presented for the problem of nanorobot assembly automation and instrumentation. The prototyping development concentrates its main focus on practical experimental nanorobot hardware manufacturing design and control system for intelligent pathological sensing and manipulation. Medical nanodevices provide a suitable way to enable the clinical treatment of patients with chronic diseases. Hence, the detailed projects use inside body 3D real time visualization and hardware verification techniques, addressing key aspects required to achieve successful integrated nanoelectronics product implementation.

B. PRACTICAL APPROACH OF NANO-ROBOTICS

The use of practical nanorobots for health care and surgery instrumentation is an emerging technology considered as an advanced product currently in development to reach the marketplace in the coming years with potentially broad biomedical applications. The ongoing developments of molecular-scale electronics, sensors and motors are predicted to enable microscopic robots with dimensions comparable to bacteria. Recent developments on the field of biomolecular computing and nanoelectronics circuitry have demonstrated positively the feasibility of processing logic tasks by bio-computers, which are promising steps to enable nanoprocessors with increasingly complexity. Studies in the sense of building biosensors and nano-kinetic devices, which is required to enable practical nanorobot operation and locomotion, have been advanced recently too. Moreover, classical objections related to the real feasibility of nanotechnology, such as quantum mechanics, thermal motions and friction, have been considered and resolved and discussions about the manufacturing of nanodevises is growing up. Developing nanoscale robots presents difficult fabrication and control challenges. The development of complex integrated nanosystems and manufacturing of devices with high performance can be well investigated and addressed via computer aided manufacturing analysis, helping pave the way for future use of nanorobots in biomedical engineering problems.

C. RECENT DEVELOPMENTS IN NANO-ROBOTICS

Reports indicate the US military has poured huge sums of money into surveillance drone miniaturization and is developing micro aircraft which now come in a swarm of bug-sized flying spies.According to various internet sources, a team of researchers at the Johns Hopkins University in conjunction with the US Air Force Office of Scientific Research at Wright-Patterson Air Force Base in Arlington, Virginia, is helping develop what they are calling a micro aerial vehicle (MAV) that will undertake various espionage tasks.

As early as in 2007, the US government was accused of secretly developing robotic insect spies when anti-war protesters in the United States saw some flying objects similar to dragonflies or little helicopters hovering above them. The US is not alone in miniaturizing drones that imitate nature: France, the Netherlands and Israel are also developing similar devices. The robotic insect can effortlessly infiltrate urban areas, where dense concentrations of buildings and people, along with unpredictable winds and other obstacles make it impractical. It can be controlled from a great distance and is equipped with a camera and a built-in microphone.Meanwhile, Israel Aerospace Industries (IAI) has produced a butterfly-shaped drone, weighing just 20 grams, which can gather intelligence inside buildings. Also mosquito robot use its super-micron sized needle to take DNA samples and fly off again at speed. All people feel is the pain of a mosquito bite without the burning sensation and the swelling of course, it can also inject a micro radio frequency identification (RFID) tracking device right under skin, and can be used to inject toxins into enemies during wars. In January 5, 2014 South Korean scientists claimed that they have developed the world's first nanorobot that can selectively target and help treat cancer. The robot is guided through the body by genetically engineered bacteria to a tumor where it releases its cargo of cancer fighting drugs.

IV. ADVANTAGES AND DISADVANTAGES OF NANO-ROBOTICS

The advantages of nano robots are that nanorobots might function at the atomic or molecular level to build devices , machines or circuits, a process known as molecular processing.Nanorobots might also produce copies of themselves to replace worn out unit, a process called self replication.A major advantage of nanorobots is thought to be its durability. Nanoscale systems can also operate much faster than their counterparts because displacements are smaller, this allows mechanical and electrical events to occur in less time.

The disadvantages are that these are essentially nano-sized robots, which can be programmed to perform specific tasks. Tasks could be to attack certain materials, such as metals, water, internal organs, or specific DNA sequences.Active nanostructures (nanobots) can be programmed to specifically target and kill humans. The smallest insect is about 200 microns; this creates a plausible size estimate for a nanotech-built antipersonnel weapon capable of seeking and injecting toxin into unprotected humans. Another threat of nanobots could arise from the Gray Goo Problem. Gray Goo is easily defined and explained as, ‘runaway nanobots’: A swarm of rapidly self-replicating nanobots, in a ravenous quest for fuel, which would consume the entire biosphere until nothing remained but an immense, sludge like robotic mass.

V. FUTURE PROSPECTS

Scientists and engineers are on a mission to create a robot so small it can fit into a human vein. Such a nanorobot could be used, for example, to target the cause of an ailment or disease and provide medication directly to the infected area. While they're still a work in progress, engineers believe that viable nanorobots may actually be ready for use in the near future -- ones that can help treat a wide range of diseases and conditions. Developers are already hopeful that nanorobots will be able to treat arteriosclerosis, break up blood clots and kidney stones and remove parasites and gout.

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