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Nanorobotics for Biomedical Applications

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Abstract: ***Nanotechnology can enable build the bridges for the human future through the use of microscopic robots comprised of nanocomponents. Nanorobotics is concerned with interactions with atomic- and molecular-sized objects, and is sometimes called molecular robotics. Nanorobotics represents the next stage in miniaturization from micro machines. This paper presents certain distinct aspects that are used to achieve a successful nanorobotic system and their three dimensional visualization in real time.The nano-robots or nanobots, is expected to revolutionize the medical industry, with the ability to treat at a cellular level and make medical applications easy and effective.***

Keywords- Nano-robotics; Biorobotics; Biomedical.

I. INTRODUCTION

Nanorobotics deals with the controlled manipulation of objects with nanometer-scale dimensions. As an atom has a diameter of a few Ångstroms (1 Å = 0.1 nm = 10-10 m), and a molecule´s size is a few nanometers.

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The fact that enormous amounts of information can be carried in an exceedingly small space, because in the tiniest cell, all of the information for the organization of a complex creature such as humans can be stored.

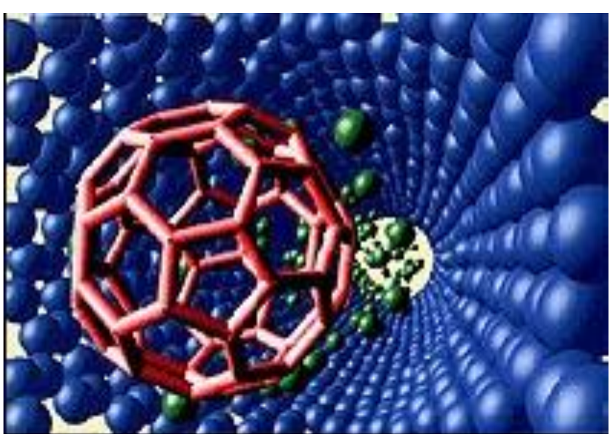

Fig-1

Many of the cells are very tiny, but they are very active; they manufacture various substances, they walk around, they wiggle; and they do all kinds of marvelous things - all on a very small scale. Also, they store information. This thought lead to the launching of nanorobotics.

Medical nanotechnology is often expected to utilize nanorobots injected into the patient to perform their treatment on a cellular level. Instead, medical nanorobots may be manufactured in carefully controlled nanofactories in which nanoscale machines are solidly integrated into a desktop-scale machine that builds macroscopic products.

II. NANO-ROBOTICS

A. Nanorobotics Thrusts

The primary emphasis is on precise actuation and control. Nanorobotics should be viewed as a long term research area with two primary thrusts. The first thrust is exploratory research into possible molecular based actuation. Examples include biological motors such as polymerase, microtubules, and myosin. The second thrust is for more near-term and applied but on a scale extending up to and including micromachines.

B. Nanorobotics encompasses

Programmable assembly of nanoscale components; design and fabrication of nanorobots with overall dimensions at the centimeter, millimeter and micrometer ranges and made of nanoscopic components; and programming and coordination of large numbers of nanorobots. Microfabrication techniques can produce intricate micromachines; however, these devices tend to be limited to 2-D construction. Developing tools such as micro-grippers and piezoelectric manipulators with nanometer level precision will make it possible to assemble both micromachined components and nanoscale components (such as carbon nanotubes) into 3-dimensional systems. These micro-to-nano 'transition' nanorobots could be of tremendous aid in studying cells and biological systems as well as nanoparticles and fibers.

C. Nanorobotic Technology

Nanorobotics, an emerging field in medicine which states that nanorobots travel inside our bodies, digging for information, finding defects or delivering drugs. Basically, we may observe two distinct kind of nanorobot utilization. One is nanorobots for the surgery intervention, and the other is nanorobot to monitor patients' body. For the first case, a most suitable approach is the tele-operation of nanorobots as valuable tools for biomedical engineering problems. Hence, for example surgery experts guiding a minimally invasive medical procedure. For cases such as monitoring the human body, the nanorobots are expected to follow a defined set of specified activation rules for triggers of designed behaviors. In such case the nanorobot is designed to be able to interact with the 3D human body environment, in order to fulfil programmed tasks.

The nanorobots require specific controls, sensors and actuators, basically in accordance with each kind of biomedical application. Sensors may be wireless ultra fast, super sensitive, and non-invasive and may use chemical, electronic or photonic based detection Nanorobot 3D design.

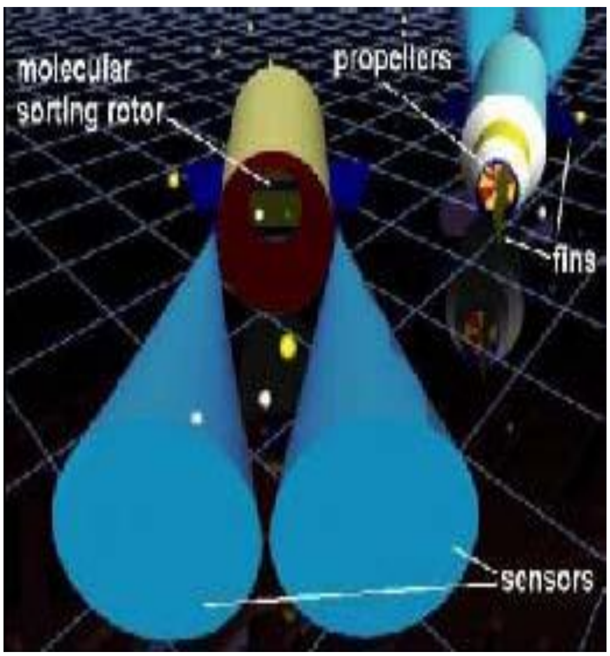

Fig 2

The depicted bluecones shows the sensors "touching" areas that trigger the nanorobots' behaviors. Computational nanoborotics approaches are being explored successfully in nanoscience and nanotechnology research, to provide researchers with an intuitive way to interact with materials and devices at the nanoscale. Virtual-environment interface to Scanning Probe Microscopes (SPMs) have been provided, giving a virtual telepresence on the surface but downscaled by a factor of about a million to one. The introduction of direct human-SPM interaction creates not only enhanced measurement capability, but also presages a more interactive technology that will enable easy nanofabrication and/or repair of nanostructures. Nanoscale object manipulation systems have been applied with the use of computer graphics for teleoperation, where the requirements for such systems have been clearly established.

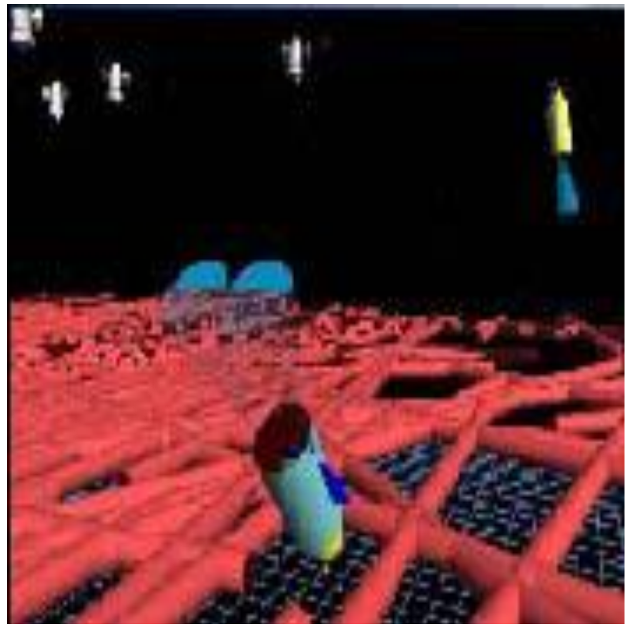

Fig 3 Sensing obstracles

Applying a simulator help us for a better insight on many reactions, considering nanorobots collective work coordination, energy consumption, and control automation. The Nanorobot Control Design (NCD) can be a big plus for robots experts and control engineers regarding good choices on the better way to apply and operate nanorobots. Developing nanoscale robots presents difficult fabrication and control challenges.

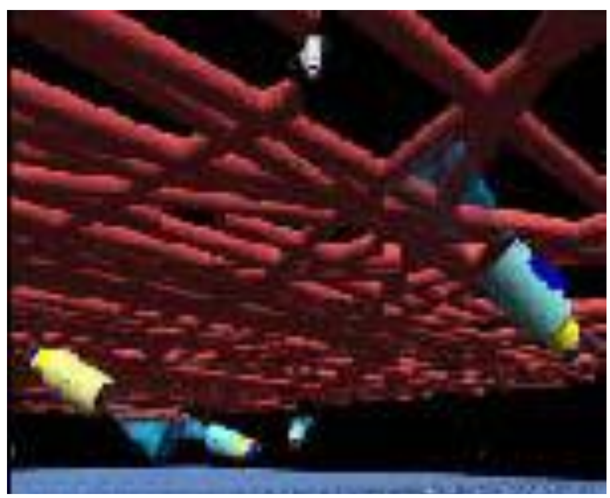

Fig 4 Nanorobot obstracle avoidence

D. Nano-robots Inside Our Bodies

Among biomedical problems, monitoring nutrient concentrations into the human body is a possible application of nanorobots in medicine. Nanorobots might be used as well to seek and break kidney stones.One interesting nanorobot utilization is also to assist inflammatory cells (or white cells) in leaving blood vessels to repair injured tissues.

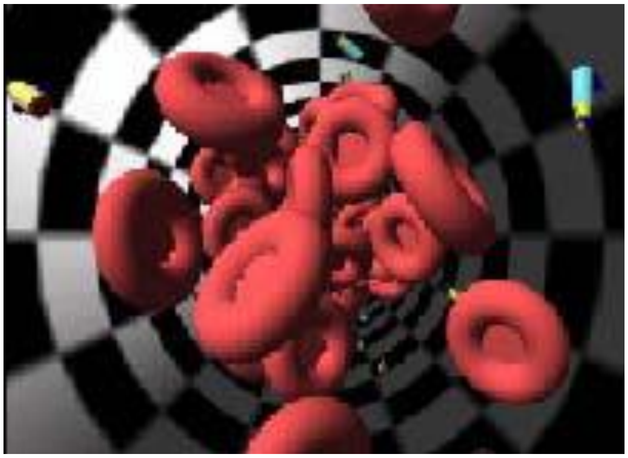

Fig 5

View of simulator workspace showing the vessel wall with a grid texture, cells and nanorobots. They are medical surgeons that find damaged cells and repair them. Using nanorobotics, doctors could create robots called nanites that travel through the human bloodstream, firing '**medicinetorpedoes**' at diseased cells, while leaving healthy cells intact.These smaller robots are able to repair and monitor intracellular structures like DNA. Nanorobots can alter **DNA** to nanorobotics reduce the number of hereditary diseases and defects in a person. The scanning tunneling microscope has allowed scientists to devise intelligent artificial antibodies, red and white blood cells and antiviral medication.

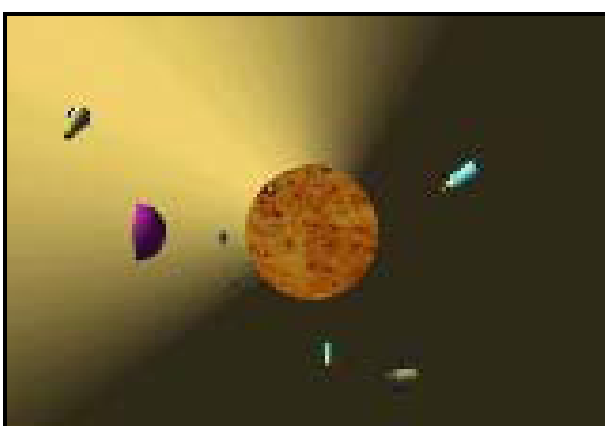

Fig 6 Blood vessel inside view.

The target plaque represented by the pink sphere is located left at the wall. The nanorobots swim near the wall region searching for the lesion. Red blood cells are responsible to carry oxygen and hemoglobin through the blood stream. Scientifically, these artificial robots will function more efficiently than their counterparts, the normal cells. Antiviral robots can act as vaccines in a human body that contain antidotes for all viruses.

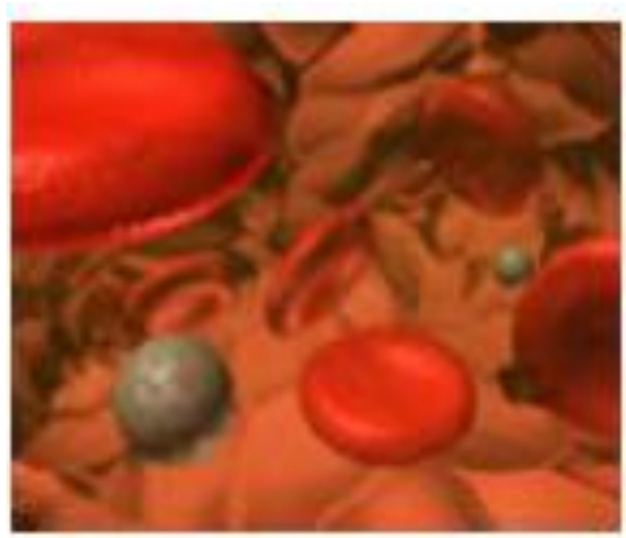

Fig 7

Heart attacks are caused due to the blockage of the coronary arteries. This technology will enable robots to travel in the blood stream to clear the blockage .The usage of nanorobots Minimized the risk and the cost of the surgery. They are intelligent robots that store enormous amounts of information, like vaccines and antidotes for illnesses. Nanorobotics will significantly improve medical applications by making them easier, less expensive and most importantly, more successful.

The ill patients will be cured and the lives of the seniors will be renewed with the use of Nanorobots. This technology will help common old age conditions, including spinal and back problems, and provide faster treatments for the ill. Cancer devastates the lives of many individuals every yearNicknamed "**Smart Bombs**", they mimic a typical lysosome in a cell, and use phagocytosis to destroy the malignant cells. A lysosome is an organelle that is involved in the digestion of the cell, and phagocytosis is an active transport method that uses small membrane bound vesicles to transfer materials over the cellular membrane. The integration of manufacturing concepts with medicine will give society the opportunity to create a stronger environment.

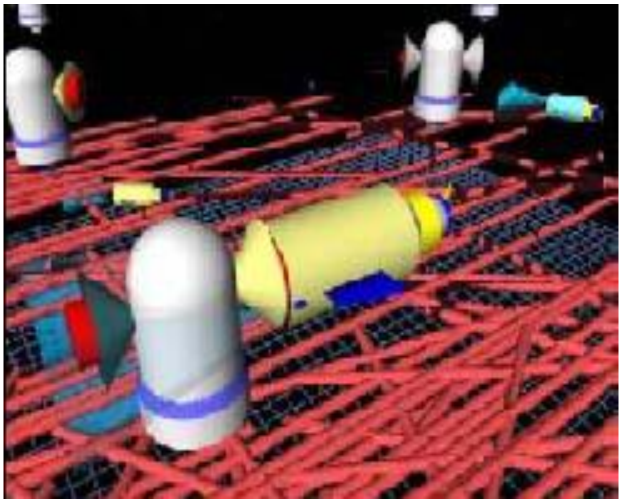

Fig 8. A nanorobot delivers a molicule to the organ inlet (represented by the molicule)

Nanorobots could also be used to process specific chemical reactions in the human body as ancillary devices for injured organs. Nanorobots equipped with nanosensors could be developed to detect glucose demand in diabetes patients, as well as to inject stem cells for the pancreas. Nanorobots will be applied in chemotherapy to combat cancer through superior chemical dosage administration, and a similar approach could be taken to enable nanorobots to deliver anti-HIV drugs. Another important capability of medical nanorobots will be the ability to locate stenosed blood vessels, particularly in the coronary circulation, and treat them either mechanically, chemically, or pharmacologically.

III. ENVIRONMENTAL APPROACH

The environmental problems have created chaos for the society. The depletion of the ozone layer has influenced global warming. The amplification of industrialism and the increased use of automobiles have affected pollution. The environmental systems can be assisted and corrected by nanorobots, as they will purify the oxygen and the carbon dioxide. Therefore, every breath will contain millions of microscopic robots. Besides the atmosphere, these robots will dissolve wastes in sewers and purify the fresh water reservoirs. Nanorobots will control various unhealthy cycles in the future and prevent such illnesses from occurring, thus reducing the need for medication. Nanorobots are versatile technologies that purify the environment, in order to benefit other medical applications. They are miniatures fabricated with the manipulation of common elements, such as carbon, and molecules, like ATP . They are able to monitor, diagnose and reconstruct biological structures. They will provide society with advanced treatments and antidotes to cure and prevent diseases. These pliable robots will purify the water supply and atmosphere, as well as eliminate common illnesses with the use of artificial blood cells and other elements of an organism. Nanorobotics will impact and benefit society, through improvements in medicine, ecology and the environment.

IV. CONCLUSION

There are some huge questions yet to be answered. How far can we take nano- robotics before it interferes with our basic humanity? Are we in danger of turning ourselves - and future generations - into strange hybrids of man and machine?

However, the ongoing developments of molecular-scale electronics, sensors and motors are expected to enable microscopic robots with dimensions comparable to bacteria.The control design and the development of complex nanosystems with high performance can be well used to help pave the way for future use of nanorobots in biomedical engineering problems. With the emerging era of molecular engineering, the development of methodologies that enable investigation to make easier automation, and evaluation of new approaches of the nanoworlds and nanorobotics behaviour, are expected to have a great impact for an effective development on nanorobotics.

REFERENCE

[1] NanoScience Today: http://www.geocities.com/cbicpg/nanoscience.htm
[2] Nanorobots Inside our Bodies?, Roland Piquepaille's Technology Trends
[3] New Nanorobotic Ideas, Nanotechnology News Network
[4] Nanorobotics Control Design and 3D Simulation, Top Computers Robotics Research Papers, RIA Rheintal Internet Access, July 2005
[5] Adriano Cavalcanti, "Nanorobotics", In 3-D Simulations, Topic In Depth, NSF - The NSDL Scout Report Vol. 4, no. 8, Computer Sciences Department, The University of Wisconsin-Madison, Madison WI, USA, April 2005.
[6] Adriano Cavalcanti, "Computational anomechatronics for Nanorobots in medicine" Special Seminar, Department Of Bioengineering, Rice University, Houston TX, USA, April 2005.
[7] Adriano Cavalcanti, Tad Hogg, "Nanorobotics System Simulation in 3D Workspaces with Low Reynolds Number".