NANOROBOTICS-THE RECENT TRENDS

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Abstract: ***Nanorobotics is emerging as a demanded field that deals with things at molecular or cellular level, majorly used in medical applications to develop new formulations related to nanotechnology to cure the major diseases. A nanorobot is a machine that can measure a size of 0.1 – 10 micrometers and constructed of nanoscale. It Allows the placement of small structures placed with precision and simplicity and Improves the quality and durability of life .As these nanorobots would have special sensors to detect the target molecules, it can be programmed to diagnose and treat various lethal diseases. The study of nanorobots serves as a lead to the field of nanomedicine. The nanorobots such as Respirocytes, microbivores and clottocytes are designed to act as artificial substitutes of blood. The proposed application of nanorobots can range from common cold to dreadful diseases like cancer, diabetes, Influenza, Cerebral aneurysm. This study of nanorobot serves as a lead to the field of nanomedicine.***
Index Terms: Nanorobotics, Nanotechnology, Dreadful diseases, Nanomedicine.

I. INTRODUCTION TO NANOTECHNOLOGY:-

Nanotechnology is defined as the study and use of structures between 1 nanometer and 100 nanometers in size. The term was coined in 1974 by Norio Taniguichi of of Tokyo Science University. It is essentially a set of techniques that allow manipulation of properties at a very small scale. "nanotechnology" today is basic research and development that is happening in laboratories all over the world. Dimensions between approximately 1 and 100 nanometers are known as the nanoscale, Nanotechnology is molecular manufacturing or, more simply, building things one atom or molecule at a time with programmed nano-scopic robot arms. A nanometer is one billionth of a meter (3 - 4 atoms wide). The trick is to manipulate atoms individually and place them exactly where needed to produce the desired structure. Nanotechnology could change how we create, transmit, store, and use energy.

Examples: super-efficient batteries, low-resistance transmission lines, cheaper solar cells.New flexible, thin film solar cells are easier to produce and install, use less material, and are cheaper to make. The nanometer is extremely small.

Nanomedicine is the process of diagnosing, treating, and preventing disease and traumatic injury, of relieving pain, and of preserving and improving human health, using molecular tools and molecular knowledge of the human body. Richard Fenyman (father of nanotechnology), He proposed employing machine tools, to make smaller medicine tools, these to used in turn to make still smaller machine tools, and so on all the way down to the atomic level called as nanorobots. These are also called as nanobot, nanoid, nanite, nanomachine, or nanomites.

II. INTRODUCTION TO ROBOTICS:-

Robotics would constitute any passive or active structure (nano scale) capable of actuation, sensing, signaling, information processing, intelligence, swarm behavior at nano scale. These functionalities could be illustrated individually or in combinations by a nano robot (swarm intelligence and co-operative behavior). So, there could be a whole genre of actuation and sensing or information processing nano robots having ability to interact and influence matter at the nano scale. Some of the characteristic abilities that are desirable for a nanorobot to function are:

a.Swarm Intelligence – decentralization and distributive intelligence
b.Cooperative behavior – emergent and evolutionary behavior
c.Self assembly and replication – assemblage at nano scale and 'nano maintenance'
d.Nano Information processing and programmability – for programming and controlling nanorobots (autonomous nanorobots)
e. Nano to macro world interface architecture – an architecture enabling instant access to the nanorobots and its control and maintenance there are many differences between macro and nano-scale robots. However, they occur mainly in the basic laws that govern their dynamics. Macro scaled robots are essentially in the Newtonian mechanics domain whereas the laws governing nanorobots are in the molecular quantum mechanics domain. Furthermore, uncertainty plays a crucial role in nano-robotic systems. The fundamental barrier for dealing with uncertainty at the nano scale is imposed by the quantum and the statistical mechanics and thermal excitations. For a certain nano-system at some particular temperature, there are positional uncertainties, which cannot be modified or further reduced.

III.WHAT IS ROBOT?

Robots that are microscopic in nature, measured largely on the scale of nanometers. They are currently in the research and development phase, but on realization they are expected to do specific tasks at the atomic, molecular and cellular level and help in bringing about many breakthroughs, especially in medical science. Nanobots can be considered to be machine version of a bacteria or virus. They can be biological or synthetic, but are adapted to perform preprogrammed tasks at the atomic level. They are expected to be autonomous in nature and powered by a small cell or battery, or even solar cells. The whole idea behind nanobots is in having a device which can interact at the nano scale and help in understanding or manipulating structures at the nanoscale level. In the development of nanobots, nanoassembly and nano-manipulation have important roles.

IV. CHEMICAL CONTENTS:-

Carbon will likely be the principal element comprising the bulk of a medical nanorobot. Probably in the form of diamond/diamondoid/fullerence/nano composites largely because of tremendous strength and chemical inertness of diamond. Many other light elements such as hydrogen, sulphur, oxygen, nitrogen, flourine, silicon,etc..It ranges in a size from 0.1-10micrometers.

V. INTRODUCTION TO NANOROBOTICS:-

Nanorobotics is emerging as a demanding field dealing with miniscule things at molecular level, and it is mainly used for medical applications. Nanorobots are nanoelectromechanical systems designed to perform a specific task with precision at nanoscale dimensions. Its advantage over conventional medicine lies on its size.

Nanorobots have chemical sensors which detect the target molecules. As a response they would emit a power signal proportional to the detected amount. This signal would arrive to a programmed microprocessor which controls the direction and velocity of the nanorobot. Nanorobots can be used in the treatment of diseases by diagnosis and can supply drug to the damaged cells.This system would maintain the robot in the pursuit of its objective. Nanorobotics refers to the still largely theoretical nanotechnology engineering discipline of designing and building nanorobots. A nanorobot is a tiny machine designed to perform a specific task or tasks repeatedly and with precision at nanoscale dimensions. It is an artificially fabricated objects able to freely diffuse in to the body of humans and interacts with specific cell at a molecular level by itself.

VI. SIZE OF NANOROBOTICS:-

Nanorobots are so small that they actually interact on the same level as bacteria and viruses. Nanorobots or nanobots are measured in nanometers or a millionth of a millimeter. More specifically, nanorobotics refers to the still largely hypothetical nanotechnology engineering discipline of designing and building nanorobots, devices ranging in size from 0.1-10 micrometers and constructed of nanoscale or molecular components.

VII. COMPONENTS OF NANOROBOT:-

The various components in nanorobot include power supply, fuel buffer tank, sensors, motors, manipulators, onboard computers, pumps, pressure tanks and structural support. The substructures in a nanorobot include:

a. Payload:- It holds the medicament or a small dose of a drug.

b. Probes and knives:- It is a instrument used to crush the clots and helps to remove the blockages and plaques in the blood vessels.

c. Microwave emitters and ultrasonic signal generators:- It helps to kill the cancerous cells and also destroys the cancerous cells.

d. Chemical sensors:- These can be embedded in the nanorobot to monitor E-cadherin gradients. Thus, nanorobots programmed for such a task can make a detailed screening of the patient whole body. In various medical nanorobotic architecture, the mobile phone is applied to retrieve information about the patient conditions. For that, it uses electromagnetic waves to command and detect the current status of nanorobots inside the patient.

e. Electrodes:- These help to kill the cancer cells by generating an electric current, and heating the cell until the effected cell dies.

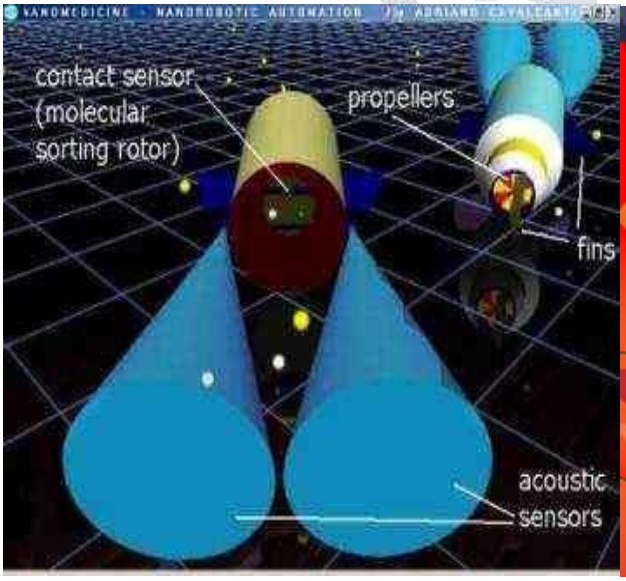
f. Lasers:- These are tiny, powerful lasers burn harmful or harzardious materials or substances like arterial plaque, cancerous cells and blood clots.

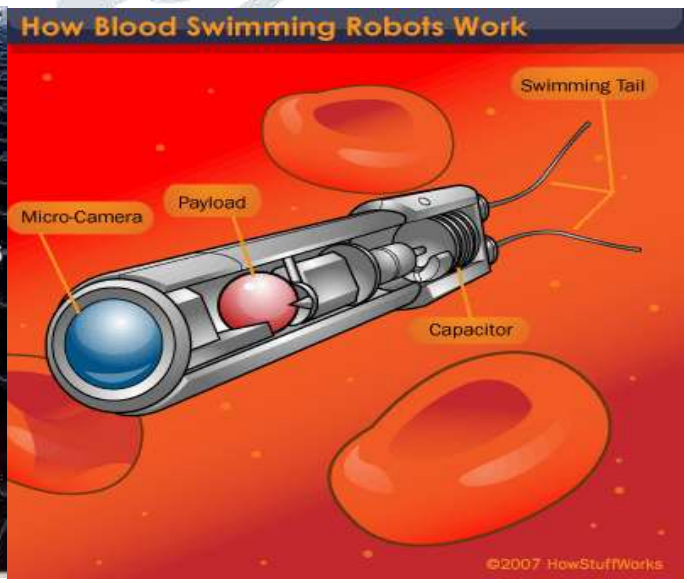
g. Micro Camera:- Involves Miniature camera, the operator can steer the robot when it is in the body.

h. Swimming tail:- It requires a propulsion to get in to the body as they travel against the flow of blood in the body.

VIII.STRUCTURE OF NANOROBOT:-

The body of the nanorobot will be constructed from carbon nanotube due to its intrinsic property where they tend to absorb near infrared light waves, which pass harmlessly through human cells. Ultrasonic sensors are attached around the body of the nanorobot for collision avoidance purposes. This is to prevent nanorobot from knocking onto each other as well as other cells in the blood vessels.





IX. WORKING OF NANOROBOTS:-

When a naorobot is introduced in to the body and it has a small and agile enough to navigate through the human circulatory system or blood stream, an incredibly complex network of veins and arteries. So, It detects the disease travels to appropriate system and provides a dose of medication to the affected diseased area. Doctors would beam ultrasonic signals into the patient's body. The signals would either

pass through the body, reflect back to the source of the signals, or both. The nanorobot could emit pulses of ultrasonic signals, which doctors could detect using special equipment with ultrasonic sensors. Doctors could keep track of the nanorobot's location and maneuver it to the right part of the patient's body. Doctors might also track nanorobots by injecting a radioactive dye into the patient's bloodstream. They would then use a fluoroscope or similar device to detect the radioactive dye as it moves through the circulatory system. Complex three-dimensional images would indicate where the nanorobot is located. Alternatively, the nanorobot could emit the radioactive dye, creating a pathway behind it as it moves through the body. Other methods of detecting the nanorobot include using X-rays, radio waves, microwaves or heat and Magnetic Resonance Imaging (MRI) device.

X. APPROACHES:-

Biochip:- The joint use of nanoelectronics, photolithography, and new biomaterials, can be considered as a possible way to enable the required manufacturing technology towards nanorobots for common medical applications, such as for surgical instrumentation, diagnosis and drug delivery. Indeed, this feasible approach towards manufacturing on nanotechnology is a practice currently in use from the electronics industry. So, practical nanorobots should be integrated as nano-electronics devices, which will allow tele-operation and advanced capabilities for medical instrumentation.

Nubots:- Nubot is an abbreviation for "nucleic acid robots." Nubots are synthetic robotics devices at the nanoscale. Representative nubots include the several DNA walkers reported by Ned Seeman's group at NYU, Niles Pierce's group at Caltech, John Reif's group at Duke University, Chengde Mao's group at Purdue, and Andrew Turberfield's group at the University of Oxford.

Positional nanoassembly :-Nanofactory Collaboration founded by Robert Freitas and Ralph Merkle in 2000, is a focused ongoing effort involving 23 researchers from 10 organizations and 4 countries that is developing a practical research agenda specifically aimed at developing positionally-controlled diamond mechanosynthesis and a diamondoid nanofactory that would be capable of building diamondoid medical nanorobots.

Bacteria based:- This approach proposes the use biological microorganisms, like Escherichia coli bacteria. Hence, the model uses a flagellum for propulsion purposes. The use of electromagnetic fields are normally applied to control the motion of this kind of biological integrated device, although his limited applications. Open Technology A document with a proposal on nanobiotech development using open technology approaches has been addressed to the United Nations General Assembly. According to the document sent to UN, in the same way Linux and Open Source has in recent years accelerated the development of computer systems, a similar approach should benefit the society at large and accelerate nanorobotics development. The use of nano-biotechnology should be established as a human heritage for the coming generations, and developed as an open technology based on ethical practices for peaceful purposes. Open technology is stated as a fundamental key for such aim.

XI. TYPES OF NANOROBOTS:-

i. **Respirocytes:-** Also called as artificial erythrocytes or red blood cells, and these are sized about 1µm diameter. The respirocyte is a blood-borne 1-micron-diameter spherical nano-medical device designed by Freitas RA. The device acts as an artificial mechanical red blood cell. It is designed as a diamondoid 1000-atmosphere pressure vessel with active pumping powered by endogenous serum glucose and can deliver 236 times more oxygen to the tissues per unit volume than natural red cells while simultaneously managing carbonic acidity. These carry oxygen and carbon-dioxide molecules throughout the body. These respirocyte would deliver 236times more oxygen when compared to natural red blood cells. These exchange gases via molecular rotors and consists of 3types of rotors. One rotor releases the stored oxygen, the second rotor captures all the carbon-dioxide molecules in the blood stream and releases at the lungs and third rotor takes in the glucose from blood stream as a fuel source.

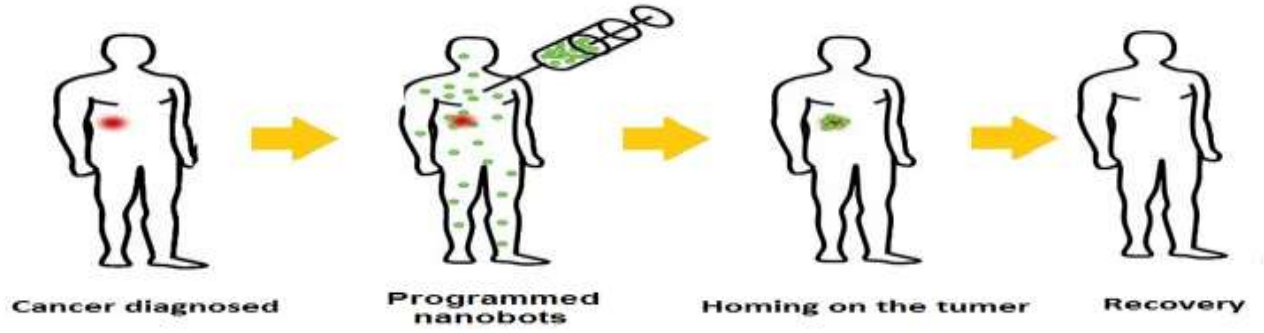
ii. **Microbivores:-** Also called as artificial white blood cells or nanorobotics phagocytes and sized about a range of 3.4 µm in diameter. It traps pathogens present in the blood stream and breaks down to smaller molecule and digest the pathogens into blood stream. So, the function microbivores is called phagocytosis, an entire cycle of phagocytosis will be completed in 30secs. The microbivore is 1000times faster acting than antibiotic aided WBCs, so these can be used in bacterial infections.

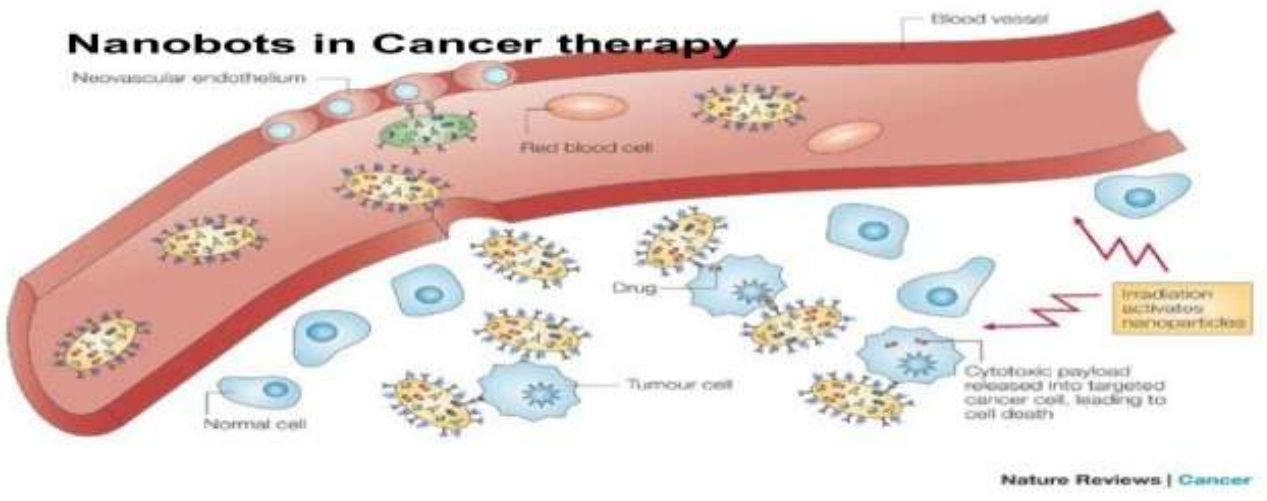
iii. **Clottocytes:-** Also called as Artificial mechanical platelets and sized about 2 µm. The process of natural blood clotting takes place in 2-5mins. In certain patients, the blood clots are found to occur irregularly these abnormality can be treated by the using corticosteriods but these drugs had side effects. So to avoid side effects, inspite of using drugs we can replace with it by clottocyte nanorobots so that would complete hemostasis by 1sec. so, the response time of clottocyte is 100-1000times faster than natural hemostatic system.

XII. APPLICATIONS:-

IN CANCER DETECTION AND TREATMENT:-

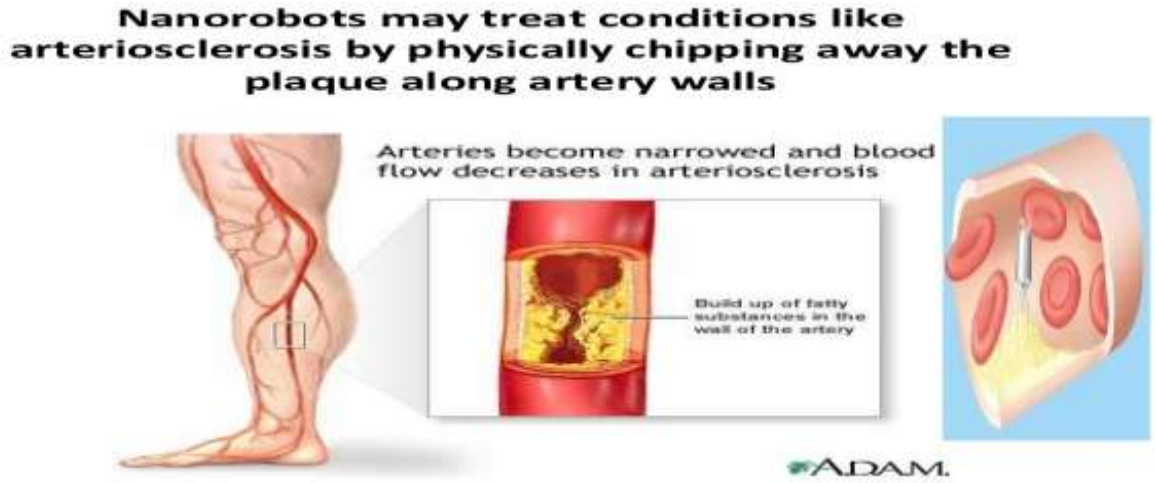
Cancer can be successfully treated with current stages of medical technologies and therapy tools. However, a decisive factor to determine the chances for a patient with cancer to survive is how earlier it was diagnosed that what means, if possible, a cancer should be detected at least before the metastasis has began . Another important aspect to achieve a successful treatment for patients, is the development of efficient targeted drug delivery to decrease the side effects from chemotherapy. Folate materials on the body of the nanorobot act as an agent that will cause the attraction of the nanorobot to the cancerous cells, which is also known as the folate-receptor cells. For modeling purposes, the folate material is modeled as an object attached to the nanorobot, rather than a coating so that the viewer can have a better visualization of the treatment process. Considering the properties of nanorobots to navigate as blood borne devices, they can help on such extremely important aspects of cancer therapy. Nanorobots with embedded chemical biosensors can be used to perform detection of tumor cells in early stages of development inside the patient's body. Integrated nanosensors can be utilized for such a task in order to find intensity of E-cadherin signals. Therefore a hardware architecture based on nano-bioelectronics is described for the application of nanorobots for cancer therapy. Analyses and conclusions for the proposed model is obtained through real time.

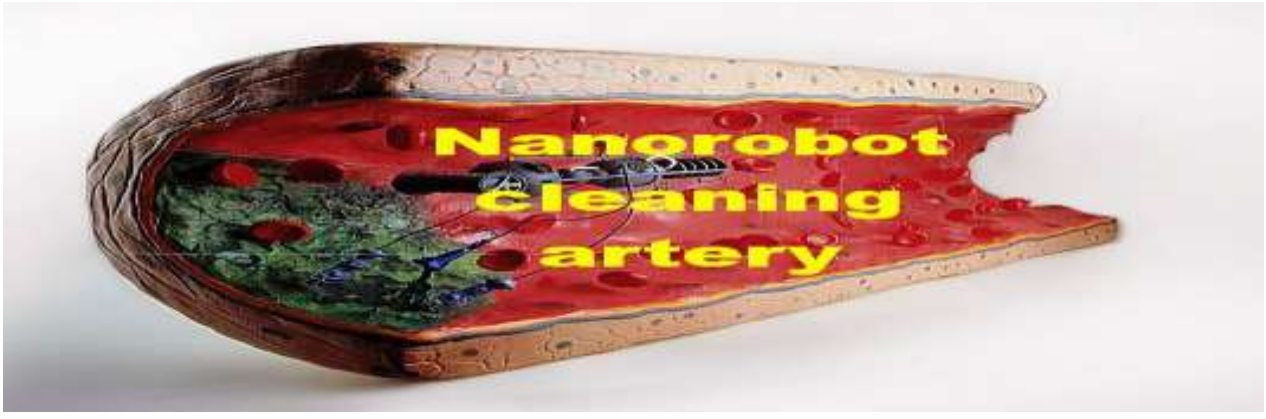




IN ARTERIOSCLEROSIS:-

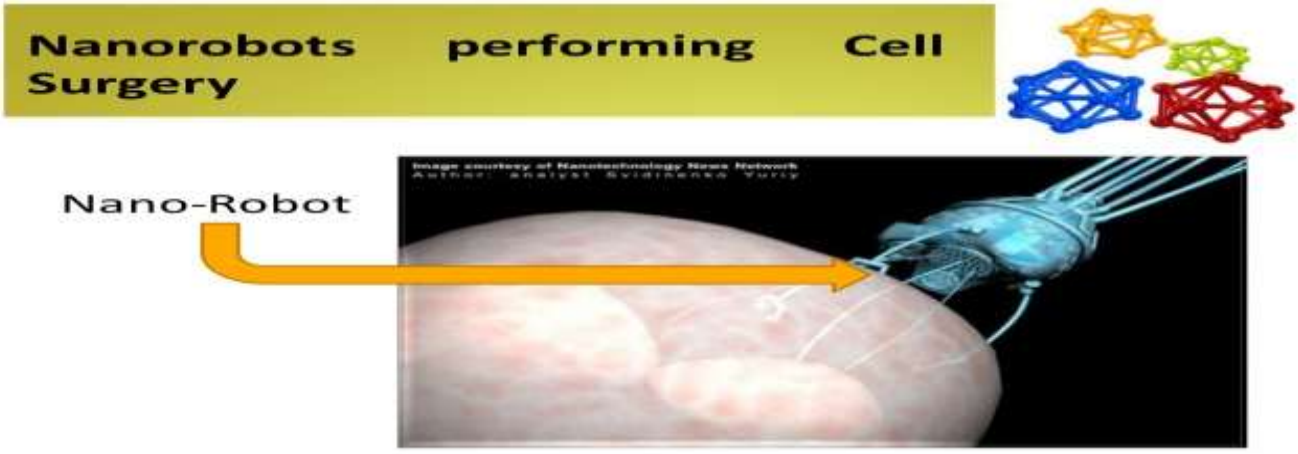
These are injected into the body via femoral artery in the leg and driven to the site of plaque is by using a long range sensor such as radioactive dye. After the plaque is detected it is grinded into micro particles using the rotating needle and diamond-chipped burr.





IN SURGERY:-

Surgical nanorobots could be introduced into the body through the vascular system or at the ends of catheters into various vessels and other cavities in the human body. A surgical nanorobot, programmed or guided by a human surgeon, could act as an semiautonomous on-site surgeon inside the human body. Such a device could perform various functions such as searching for pathology and then diagnosing and correcting lesions by nano-manipulation, coordinated by an on-board computer while maintaining contact with the supervising surgeon via coded ultrasound signals.

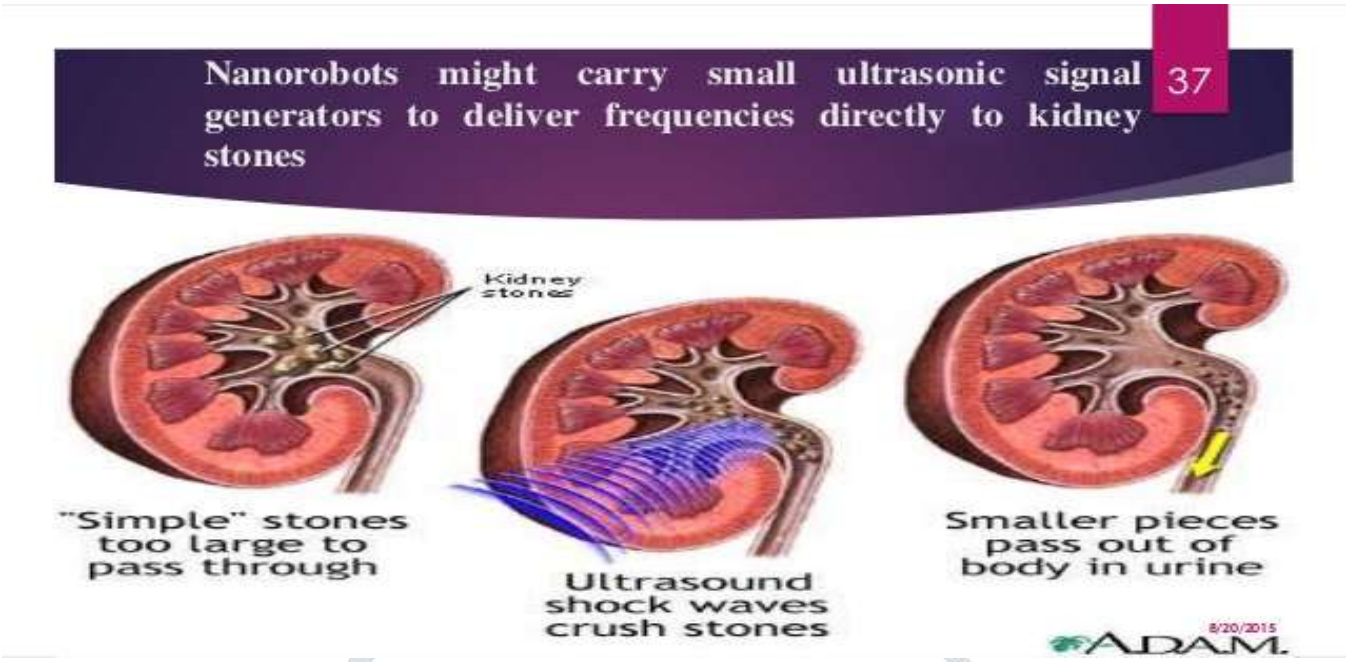


IN DENTISTRY:

The Growing interest in the future of dental applications of nanotechnology is leading to the emergence of a new field called Nanodentistry. Nanorobots induce oral analgesia, Desensitize tooth; manipulate the tissue to re-align and straighten irregular set of teeth and to improve durability of teeth. Further it is explained that how nanorobots are used to do preventive, restorative, curative procedures. Nanodental techniques involve many tissue engineering procedures for major tooth repair. Mainly nanorobotics manufacture and installation of a biologically autologous whole replacement tooth that includes both mineral and cellular components which leads to complete dentition replacement therapy. Nanodentistry has given material that is nanostructured composite material, sapphire which increases tooth durability and appearance. Upper enamel layers are replaced by covalently bonded artificial material such as sapphire. This material has 100 to 200 times the hardness and failure strength than ceramic. Like enamel, sapphire is a somewhat susceptible to acid corrosion. Sapphire has best standard whitening sealant, cosmetic alternative. New restorative nano material to increase tooth durability is Nanocomposites. This is manufactured by nano agglomerated discrete nanoparticles that are homogeneously distributed in resins or coatings to produce nanocomposites. The nanofiller include an aluminosilicate powder having a mean particle size of about 80nm and a 1:4ratio of alumina to silica. The nanofiller has a refractive index of 1.503, it has superior hardness, modulous of elasticity, translucency, esthetic appeal, excellent color density, high polish and 50% reduction in filling shrinkage. They are superior to conventional composites and blend with a natural tooth structure much better.

IN DIAGNOSING AND TREATMENT OF DIABETES:

Nano robotics may use embedded nano biosensors to monitor blood glucose levels, transmit every two hours this information through RF signals for mobile phones carried with the patients. Instead of taking Repeated blood samples to control glucose levels the level of sugar in the body can be observed via constant glucose monitoring using medical nanorobotics. This procedures avoid comfortableness &inconvenience. It may also avoid eventually infections due the daily small cuts to collect blood samples. Glucose carried through the blood stream is important to maintain the human metabolism working healthfully, and its correct level is a key issue in the diagnosis and treatment of diabetes. Intrinsically related to the glucose molecules, the protein hSGLT3 has an important influence in maintaining proper gastrointestinal cholinergic nerve and skeletal muscle function activities, regulating extracellular glucose concentration. The hSGLT3 molecule can serve to define the glucose levels for diabetes patients.



Breaking Up Of Kidney Stones And Blood Clots

CRYOSTASIS:

The extraordinary medical prospects ahead of us have renewed interest in a proposal made long ago that the dying patient could be frozen, then stored at the temperature of liquid nitrogen for decades or even centuries until the necessary medical technology to restore health is developed Called cryonics, this service is now available from several companies. Because final proof that this will work must wait until after we have developed a medical technology based on the foundation of a mature nanotechnology, the procedure is experimental. We cannot prove today that medical technology will (or will not) be able to reverse freezing injury 100 years from now. But given the wonderful advances that we see coming, it seems likely that we should be able to reverse freezing injury - especially when that injury is minimized by the rapid introduction through the vascular system of cryo protectants and other chemicals to cushion the tissues against further injury.

NANOROBOTS IN GENE THERAPY:-

Medical nanorobots can readily treat genetic diseases by comparing the molecular structures of both DNA and proteins found in the cell to known or desired reference structures. Any irregularities can then be corrected, or desired modifications can be edited in place. In some cases, chromosomal replacement therapy is more efficient than in cyto-repair. Floating inside the nucleus of a human cell, an assembler-built repair vessel performs some genetic maintenance. Stretching a supercoil of DNA between its lower pair of robot arms, the nanomachine gently pulls the unwound strand through an opening in its prow for analysis. Upper arms, meanwhile, detach regulatory proteins from the chain and place them in an intake port. The molecular structures of both DNA and proteins are compared to information stored in the database of a larger nanocomputer positioned outside the nucleus and connected to the cell-repair ship by a communications link. Irregularities found in either structure are corrected and the proteins reattached to the DNA chain, which re-coils into its original form. With a diameter of only 50 nanometers, the repair vessel would be smaller than most bacteria and viruses, yet capable of therapies and cures well beyond the reach of present-day physicians. With trillions of these machines coursing through a patient's bloodstream, "internal medicine" would take on new significance. Disease would be attacked at the molecular level, and such as cancer, viral infections and arteriosclerosis could be wiped out.

NANO-ACTUATORS AND NANOSENSORS:-

It aims at developing drug delivery microrobotic systems (composed of nano Actuators and nano Sensors) for the propulsion and navigation of ferromagnetic microcapsules in the cardiovascular system through the induction on magnetic gradients. New approach for diagnosing and treating breast cancer : Enhanced diagnostics using MRI, In-Vivo propulsion and navigation,Targeted drug delivery using functionalized nanovectors.

BRAIN ANEURYSM:-

The nano robot for brain aneurysm prognosis, they are using computational nanotechnology for medical device prototyping. This is consisting of three main Equipment-prototyping, the manufacturing approach and inside-body transduction. It is the computational nanotechnology provides a key tool for the fast and effective development of nano robots, and that is supports of investigation to address major aspects on medical instrumentation and device prototyping. A similar approach was taken by industry to build racing cars, airplanes, submarines and medical devices. The bio molecules are too small to be detected reliably instead the robot relies on chemical nano biosensor contact to detect them. Brain aneurysms are taken for modeling the study of nano robots sensing and interaction within the deformed blood vessel. Intracranial concentrations are small and some false positives can even occur due to some positive functions of N-oxide with semi carbazone . The nano robots must detect protein over expression and the setup for sensing and control activation can be modified for different values, We treat any nano robots not responding while within the workspace as if they did not detect any signal, so they flow with the fluid as it leaves the workspace. If the nano robot's electrochemical sensor detects NOS in low quantities or inside normal gradient it generates a weak signal lower than 50 nA .When activated, the nano robots' sensors also indicate their respective Position at the moment that

they detected a high protein Concentration providing useful information about the vessel bulb location and dimensions. To illustrate the proposed approach, the nanorobots must search for protein over expression signals in order to recognize initial stages of aneurysm. An advanced nano mechatromics simulator, using a three- dimensional task-based environment, is implemented to provide an effective tool for device prototyping and medical instrumentation analysis. Thus, based on clinical data and nano-bioelectronics, the proposed model offers details about how a nanorobot should help with the early detection of cerebral aneurysm.

XIII. CONCLUSION:-

Nano technology with all its challenge & oppurtunities will become a part of our future. They will provide personalized treatments with improved efficacy and reduced side effects. The research and development of nanorobots for common application in fields such as medicine and defense technology should lead as for a safer and healthier future. When the severe side effects of the existing therapies are been considered, the nanorobots are found to be more innovative, supportive to the treatment and diagnosis of lethal diseases. Diagnostic & Treatment tool for patients with cancer and Diabetes. The researchers are optimize for the products based upon this technology better therapy and improved one. The Nanomedicine is slowly but steadily whering in the new industrial revolution.

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