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Nanorobotics: The Future of Medicine

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Abstract- Nanorobotics is an exciting field that combines nanotechnology and robotics to revolutionize medicine. These tiny robots, smaller than a speck of dust can navigate through our bodies to deliver targeted treatments perform precise surgeries and even repair damaged cells . With their ability to access hard to reach areas and perform tasks at the molecular level nanorobotics hold immense potential in improving outcomes healthcare and transforming the future of medicines.

Index Terms- Nanorobotics, Respirocytes, Clottocytes, Swimming nanorobtics, Nanocapsule

I. INTRODUCTION

Nanotechnology refers to the branch of science and engineering which deals with the creation of materials, devices and system through the manipulation of individual atoms and molecules. The technology that is built from single atoms and which depend on individual atoms or function. Also known as father of nanotechnology. The nanotechnology concepts first introduced by american physicist Richard ,P.Feynman (1918-1988) .

1. Predicted Several Aspects in Todays Nanotechnology

- Advanced microscopy
- Possibilities of atom to atom assembly.

Nobel price winner richard feymann first conceived the idea of molecular manufacturing in his 1959 speech, “there’s plenty of room at the bottom .”.the richrad feyman also first scientist to suggest that devices and material could be somebody be fabricated to atomic specification .
The term nanotechnology had been coined by norio-taniguchin in1974. The 1986 k.eric dpexler wrote “engines of creation”and introduced the term nanotechnology from the scientific research really expanded over the last decade .[21]

2. What is nanorobotics?

Nanorobotics is the enginerring technology firld creating machines or robots whose componentsor at or close to scale of nanometer .

More specifically nanorobotics refers to the nanotechnology and building discipline of designing and building the nanorobotics with device ranging in size from 0.1-10 micrometer and constructed of nanocapsule or molecular components

Nanorobotics are largely in the research and development place, but some primitive molecular machines have a switch approximately 1.5 micrometers across, capable of counting specific molecules in a chemical sample.[21] 2.2.1 Nanorobots- Nanorobots are combination of two technologies: - robotics and nontechnology. It is a tiny machine which is designed to perform specific task or tastes reputedly and with precision at nanosacale dimension.

Nanorobotics is any active structure which is capable of either one or a combination of two or more following of the actuation ,sensing ,manipulation ,propulsion, sign sling and information processing at nanoscale .

Nanaorobots can function at the atomic or molecular level to built devices ,machines or circuites, a process konown or molecular manufacturing ,however they can produce copies of themselves to replace worn out ants a process called self replication.[3]

The size of nanorobotics is 10^-9 =1nm

We also called nanorobots as nanobots ,noontides nanites ,nanomachines.

The first useful application of nanomachines might in medical technology ,which could be used to identity and destroy cancer cells [18].

Structure
Ananorobot consists of the following parts

- **Microprocessor:** Comprehensive working of nanorobots is commanded by this
- **Magnetic Switch:** This is utilized to switch on & off the nanorobot
- **Manipulators:** Regulates locomotion and velocity of nanorobots
- **Payload:** This part stores drugs needed, releases them at required locations

- **Power Source:** To keep nanorobots workable, electromagnetic energy is supplied via nanocircuits
- **Motor:** This makes the nanorobots move in the blood vessels
- **Sensors:** These sensors recognize the particular chemicals from body cells, thus nanorobots are guided to targeted locations
- **Micro Camera:** The operator guides the nanorobot through the route with the help of a small-sized camera .[23]

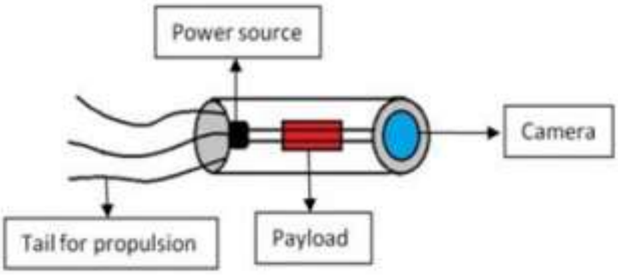

fig.01- Nanorobot

- Nanorobotics must have size between 0.5 to 3 microns large with 1-100nm parts . Nanorobotics of larger size than the above will block capillary flow
- They prevent themselves, from being attacked by the immunse system having a passive diamond exterior.
- It will communicate with the doctor by having a passive; diamond encoding massagers to aortic signals at carrier assure frequencies of 1-100 microns.
- It might produce multiple copies of it to replace worn out units a process called self replication.

After the condition of tasks, it can be retrieved by allowing it so to excuse them vial the usual human excretory channels or can also be removed by active scavengers system.

3. Working of Nanorobotics

When an implantation of a tiny robot into our blood system. The robot detects the cause of the fever travels to the appropriate system and provides a dose of medication directly to the infected area.

Elements – carbon is be the principal element comparing the bulk of a medical nanorobot probably in the form of diamond or diamond or diamondiol nanoparticles .

Many other light elements such as hydrogen ,sulfer,oxygen , nitrogen ,fluorine ,silicon, etc will be used for the special purpose in nanoscale gears and other components.

Swimming Nanorobtics- Swimming nanorobotics are micro or nano robots that can swim when injected into the body via vascular can digestive system by using blood sugar or fuel .

They are used to perform medical task the main aim of these root is to major surgery and enhance the diagnosis of disease. The capabilities of nanorobotics include therapeutics and diagnosis function such as ultra sounding biopsy laser and produce heat by restorable arm.[11]

4. Mechanism

The attached bacteria by rotating their flagella push the microscope to flowered by using different chemicals the on /off motions of microrobotes are controlled.

These chemicals bind to the flagella motor a restricted their movement .mainly used chemicals are delta and copper ions, are used to stop their motion and EDTA used to restrict their motion.

The swimming robots contain robotic body. Poly microscopes which are also called as micro bodies. the method used in the micro robots is bacteria propulsion method , in which the bacteria also propelled by rotating their flagella with high speed than the bacteria to the micro bead. Targeted delivery:

Nanobots can be made to carry payloads like medications, genes, or imaging agents to particular cells, tissues, or organs
Active transport: To travel through the body, nanobots can be propelled by magnetic fields, ultrasonic waves, or chemical energy.

Passive Transport: To get to their destination, nanobots can be transported by physiological fluids like blood or lymphatic fluid.

Cell Uptake: By using processes like endocytosis or phagocytosis, nanobots can be made to be absorbed by cells.
Tissue penetration: Nanobots can be made to pierce intestine or blood-brain barriers, among other tissue barriers.

Sensing and Reporting: Nanobots can be fitted with sensors to monitor physiological factors such as ph, temperature, and biomarkers and relay the results back to outside devices.

Therapeutic Action: Drug release, gene editing, and cell killing are just a few of the therapeutic acts that nanobots can carry out.

Imaging and Diagnostics: Fluorescence microscopy, MRI, ct, and other imaging modalities can all benefit from the employment of nanobots as contrast agents.

Manipulation of Cells: Nanobots are capable of carrying out many tasks on cells, including causing them to die, change their behavior, or transport cargo.

Tissue Engineering: By using scaffolds for tissue regeneration, nanobots can be employed to build or repair tissues.

Typical building blocks for nanobots are
Lipids, such as liposomes or lipid-based nanoparticles Polymers: peg and plga are examples of biodegradable polymers Metals: nanoparticles of iron oxide, gold, or silver. Materials made of carbon, such as graphene or carbon nanotubes.

Biomaterials: DNA, proteins, or cells[25]

Numerous body systems are compatible with nanobots, including:

- **Circulatory System:** By passing through blood vessels, nanobots can target particular tissues or cells.
- **Nervous System:** By interacting with neurons, nanobots can sense neural activity or administer therapeutic substances.
- **Immunological System:** By adjusting immunological responses, nanobots can either promote or inhibit inflammation.
- **Digestive System:** Nanobots can administer therapeutic medicines or detect biomarkers by focusing on particular cells or tissues in the stomach.
- **Musculoskeletal System:** Certain cells or tissues can be targeted by nanobots

5. Prepration of Nanobotes in Lab Scale
In a laboratory context, some typical methods for creating nanobots include:

- **Liposome Formation:** Spherical nanobots made of phospholipids.
- **Polymerization:** The chemical process that yields polymeric nanoparticles.
- **Metal Nanoparticle Synthesis:** The process of creating metal nanoparticles by physical or chemical reduction.
- **Microfluidic Assembly:** Assembling nanobots from smaller parts by means of microfluidic devices.
- **3d Printing:** Using 3d printing methods, intricate nanobot constructions can be produced.
- **Bioconjugation:** The process of integrating biomolecules into nanoparticles to produce useful nanobots.

Production of Nanobots in a Lab Scale

- Microscopes: To observe and describe nanobots.
- Spectrophotometers: To examine the optical characteristics of nanobots.
- Chromatography systems: To separate and examine the various parts of nanobot.
- Microfluidic apparatus: For the construction and evaluation of nanobots.
- Cleanroom facilities: To ensure accurate control over contamination and minimise

Methods utilised in the creation of artificial nanobots are

- Synthetic chemistry
- The sol-gel method
- Small-scale fluid dynamics
- The use of 3d printing
- Conjugation via biosynthesis[12]

II. DETECTION OD DISEASES IN BODY BY NANOBOTS

Biomarker detection: Certain biomarkers, such as proteins, genes, or metabolites linked to diseases, can be found by nanobots.

- **Imaging:** To see tissues or organs, nanobots can be outfitted with imaging agents like fluorescent dyes or magnetic resonance imaging (MRI) contrast agents.
- **Sensor Arrays:** To monitor variations in ph, temperature, or other physiological parameters, nanobots are equipped with sensor arrays.
- **DNA Analysis:** To find genetic alterations or mutations linked to diseases, nanobots may analyse DNA. Protein analysis: In order to identify illnesses, nanobots can examine the amounts or changes in proteins.
- **Analysis of Metabolites:** Nanobots are able to identify variations in metabolite levels too

1. Sensing Techniques, including:

- **Optical Sensing:** This technique uses light to identify tissue alterations or biomarkers. Electrochemical sensing: This method finds biomarkers or tissue alterations via electrical signal detection.
- **Magnetic Sensing:** This technique uses magnetic fields to identify tissue alterations or biomarkers.

Mechatronic detection: Silica, nanobots can be made to move in a manner.[21]

III. VISVALIZTION OF NANOBOTES

The tiny size of nanobots (usually between one and one hundred nanometres) makes it difficult to see them with the unaided eye. Nonetheless, scientists employ a variety of techniques to observe and monitor nanobots within the body: Fluorescent labeling: By using fluorescent dyes to identify them, nanobots can be seen under fluorescent microscopy.

Magnetic resonance imaging (MRI): Researchers can monitor the movement of nanobots by designing them to be visible on MRI images.

Computerized tomography (CT) scans: Researchers can monitor the movement of nanobots by designing them to be visible on ct scans.

Ultrasound imaging: Researchers can track the movement of nanobots by designing them to be visible on ultrasound scans.

IV. DETECTION OF NANOBOTS

Since nanobots are microscopic and may have biomimetic qualities, it can be difficult to detect them in the body. Nonetheless, there are a number of ways to find and follow nanobots:

- **Imaging Methods**-Magnetic resonance imaging, or MRI - ct scans, or computerized tomography - pet scans, or positron emission tomography - microscopy using fluorescence - cot, or optical coherence tomography
- **Technologies for Sensing**:- Biosensors, such as sensors for glucose chemical sensors (ph sensors, for example) - physical sensors, such as those measuring temperature
- **Methods of Tracking:** Labelling techniques include fluorescent, magnetic, acoustic, and radioisotope labelling.
- **Biological Techniques**: Immunoassays, such as ELISA, - assays based on cells, such as cytotoxicity assays
- **Manual Techniques**: The study of microscopy, such as electron microscopy the use of spectroscopy, such as Raman spectroscopy,
- **Chromatography**—Size exclusion chromatography, for example— in order to improve detectability, nanobots can be made with:
- **Contrast Agents**: Substances (such as iron oxide and gadolinium) that improve imaging signals
- **Fluorescent Markers:** Light-emitting molecules (such as fluorescent dyes) Radioactive labels: Radiation-emitting isotopes, such as technetium-99m Magnetic materials: Materials, such as iron oxide, that react to magnetic fields

Nanobots' Lifespan in our Body

- For tiny, non-targeted nanobots that the immune system swiftly eliminates, minutes to hours.
- Hours to days: for cells or tissues-specific targeted nanobots.
- Days to weeks: for biodegradable nanobots, which the body breaks down gradually.
- For non-biodegradable nanobots that linger in the body, weeks to months.

In order to increase the lifespan of nanobots, scientists employ techniques like:

- **Surface Modification:** Applying biocompatible coatings or ligands to nanobots.
- **Material Selection:** Selecting materials that are appropriate for the application, whether they are biodegradable or not.
- **Design Optimization:** Reducing clearance and improving targeting by refining the size, shape, and structure of nanobots.
- **Combination THERAPIES:** Increasing the effectiveness of existing treatments by combining nanobots with them

V. ROUTES OF ADMINISTRATION OF NANOBOTS

Depending on the intended use and site, there are multiple ways to introduce targeted nanobots into the body. Here are a few potential methods for introducing certain nanobots:

- **Intravenous Injection:** A vein can be used to administer a nanobot injection into the bloodstream.
- **Subcutaneous Injection:** An injection of nanobots can be made beneath the skin.
- **Inhalation:** It is possible to breathe in nanobots.
- Oral administration: Liquid or tablet form, nanobots can be consumed orally.
- **Topical Application:** Direct application of nanobots to the skin or mucous membranes is possible.
- **Surgical Implantation:** During surgery, nanobots may be inserted.
- Catheter-Based del how the nanoboats operate

Removal of Nanobotes from Body

Depending on how they are made, where they are located, and how they are designed, there are several ways to remove nanobots from the body. To get rid of nanobots, use these methods:

- **Excretion:** It is possible to build nanobots that will expel waste through sweat, faeces, or urine.
- **Biodegradation:** Over time, biodegradable nanobots can decompose spontaneously within the body.
- **Enzymatic Degradation:** Nanobots composed of biological components can be broken down by enzymes.
- **Magnetic Removal:** By using external magnetic fields, magnetic nanobots can be eliminated.
- **Acoustic Removal:** Ultrasonic waves can be used to get rid of nanobots.
- **Optical Removal:** Laser light and other optical techniques can be used to eliminate nanobots.
- **Surgical Removal:** It can be necessary to remove nanobots surgically in some circumstances.

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Depending on how they are made and used, nanobots can function in the body in a variety of ways. The body can use nanobots in the following ways:

- **Targeted Delivery:** Medications, genes, or other therapeutic substances can be delivered straight to particular cells or tissues by means of nanobots.
- **Sensing and Tracking:** Biomarkers, ph, temperature, and other physiological factors can all be detected and tracked by nanobots.
- **Imaging and Diagnostics:** Fluorescence microscopy, mri, ct, and other imaging modalities can all benefit from the employment of nanobots as contrast agents.
- **Therapeutic Action:** Drug release, gene editing, and cell killing are just a few of the therapeutic acts that nanobots can carry out.
- **Manipulation of Cells:** Nanobots are capable of modifying, delivering cargo, or even causing cell death in cells.
- **Tissue Engineering:** Nanobots are capable of building
- **Ivery:** a catheter that is placed into an artery or vein can be used to administer nanobots.
- **The Use of Microinjection:** Nanobots
- Enzyme replacement: The body can use nanobots to transport enzymes to replace missing or malfunctioning ones.
- **Gene Therapy:** To cure genetic illnesses, nanobots can transfer genes to particular cells or tissues.
- **Cancer Treatment:** By destroying cancer cells, nanobots can stop tumour growth and metastasis.

Applications of Nanorobots

Nanorobots not only find or assess toxins in the surroundings but also, can be utilized in the healthcare sector. Robots of nano or micro size are planned for eradication or cure of medical ailments involving blood coagulation. Thickening/hardening of the wall of arteries, malignancy, stones in the kidney, etc. The utilization of sophisticated nanomechanical systems aids smart drug delivery, auditing the disorders such as hyperglycemia. Biological jobs at the cell stage may be carried out by nanorobots with suitable configurations. For example, these devices can be introduced to the bloodstream and these may damage tumor cells or viruses"

Diabetes

Nanorobots are thought of as the latest feasibility related to the medical sector to enhance diagnostics, medical care, and instrumentation. Multiple times a day individuals suffering from hyperglycemia should get their levels checked so that the range remains normal. These ways to check levels of glucose can be difficult and distressing. This issue can be resolved by utilizing nanorobots, these devices can regularly examine levels of glucose .this can lead to betterment in suffering individual's life quality and it can make sure that glucose levels remain normal.

Heart Attack

Heart attacks may be averted by nanorobots. Blood vessels are obstructed because of cholesterol and fatty material which leads to a heart attack. The fat and cholesterol from vessels can be eradicated by nanorobots. Nanorobots might remove yellowish fat from inside blood vessels. Cholesterol and fat lowering drugs such as atorvastatin, and lovastatin. Nanorobots will transport such drugs to the required location in the body.

Arteriosclerosis

In this situation, the fat gets built in the lumen of blood vessels. This can be treated by nanorobots by removing the plaque in the lumen of arteries.

Nerve Regeneration

Nanorobots can act upon damaged nerves and cure those. Amphiphiles are small rod-like nanofibers and are included in nanorobots, which are fabricated by Samuel stupp and john kessler at northwestern university, Chicago. These bots are covered with amino acids and will stimulate the development of neurons and avert the forming of scars. In animal studies on rats, nanorobots were found to recover the rats from spinal damage.

Cancer Detection and Treatment

Reducing the adverse effects of chemotherapy by effective smart drug delivery is a crucial condition in attaining favorable treatment. In cancer, management nanorobots can be utilized because of their easy navigation in blood. In the beginning time of the formation of cancer cells, these can be easily recognized by nanorobots with entrenched biochemical sensors and it is computed to only find affected cells and unaffected cells are left. Intensification of e-cadherin signals can be found by the use of joined sensors. Scrutiny and results for the projected model are acquired via real-time 3d simulation genetically altered salmonella bacteria have been shown to carry nanorobot called bacteriobots and are drawn towards tumor cells because of signals released by cells. The drug can be transferred precisely to tumor cells and healthy cells are left by nanorobots and the sufferinging individual is safeguarded from adverse effects of chemotherapy.

The drug can be transferred precisely to tumor cells and healthy cells are left by nanorobots and the suffering individual is safeguarded from adverse effects of chemotherapy.[15][16][17]

Anti-HIV Nanobot

Generally, animal cells have dimensions of 10,000-20,000 nanometres. This allows nano-sized devices to penetrate the cells and the components of cells and can reach out to DNA and proteins. The virus cannot be killed by zidovudine but HIV can be restricted by it. The genetic material of the virus can be damaged with the utilization of nanorobots. Such devices constitute nano-biosensor, the electronic circuit to convert data to other forms, and a vessel including a great amount of deoxyribonuclease and ribonuclease enzyme

Surgery

Sophisticated surgeries can be eased by the introduction of robots and also broaden the abilities of surgeons. Procedures like these allow very low invasion surgeries with great accuracy and thus it is a dynamically evolving field. Small-sized robots can move through the narrower body parts and reach far remote sites and perform surgical procedures that are difficult to perform in contrast to large-sized robots. Latest developments in nanorobots demonstrate significant affirmation to removing restraints and utilizing small-sized bots for accurate surgical procedures nanorobots will be able to carry out medical procedures on the retina, membranes nearby to it, and operating microscope surgery of the human eye. Nanorobots do not require to be introduced into the eye rather can be added to other parts of the body, from there these could find their way to the eye for drug delivery. A model fragile surgical procedure is surgery related to the fetus. This surgery poses a great possibility of the death of the mother or baby. Because of nanorobots, this procedure can achieve 100% success as they would have better reach to the site of operation.[4]

Myocardial Infarction

Nanorobots can find the aspects accountable for myocardial infarction and can be eradicated by nanorobots as well. A surgical procedure involving nanorobots in the management of myocardial infarction will not have adverse effects as those found in a common kind of surgery that relies upon the surgical abilities of the surgeon.

Gene Therapy

Genetic disorders can be cured by utilizing nanorobots by examining, in contrast, the molecular arrangement of dna to structures of reference. Distortions can be rectified if present or required alterations can also be done chromosomal replacement therapy can be better adept than cy to repair. A few genetic sustenance's are carried out by an assembler-built repair vessel that lies on the surface of the nucleus of the human cell. The nanodevice elongates supercoiled DNA in the middle of its inferior couple of robotic arms, and delicately pulls not wound strand via an orifice in prow for examination. Arms that are above disassembled regulatory proteins, and keep those in an intake port .

Alzheimer's Disease (AD)

Commencement and development of ad could be detected by nanorobots in elder people by examining blood for β-amyloid and tau which are biological markers of ad. Aβ could be eliminated by nanorobots which can lead to decreased central pathology and thus enhance cognition or reduce the rate of cognitive reduction as per peripheral sink theory. If nanorobots would be able to cross the blood-brain barrier then precisely they can tackle the condition. Drugs that antagonize inflammation, tau, and amyloid could also be reached the central nervous system (CNS) by nanorobots. [10]

Kidney Stones

Agony can be intense in the case of kidney stones, the greater is the size of the stone, the greater is the difficulty for the stone to move out. Utilizing a laser nanorobot may be able to disintegrate the stone into small fragments.

Skin Diseases

Nanorobots constituting cream could be utilized. Nanorobots may eliminate the dead skin cells, eradicate exuberance oils, the addition of absent oils, put the required quantity of moisturization, and accomplish the task of deep pore cleansing by going to pores.

Tissue Reconstruction

Nanoparticles with nanobots can be planned in such a way that it imitates bone arrangement. By utilizing ultrasound on bones, nanoparticles are formed from the conclusions of ultrasound. At the site of a cracked bone, nanorobots congregate to form a structure that becomes a component of bone. Thus, devices like these can be beneficial in cracked bones, other situations like arthritis, etc

Anaesthesia

As general and local anaesthesia nanorobots can be utilized. Because these devices are greatly precise and goal-focused, there is a decline in morbidity and death rate associated with anaesthesia.

Body Surveillance

There is a sudden important change in diagnostic because of nanorobots making it feasible to constantly audit the crucial parameters and transmission wirelessly. This also led to a rapid reaction in situations where crucial parameters get altered suddenly and can also alert in case of probable danger.

Advantages

The advantages of nanorobots are as follows :

- Nanorobot drug delivery system utilization with elevated bioavailability
- Specific treatment, for instance, cure of cancer cells
- Even access to the far parts of the human body which are not eastly operatable
- Nanorobots have a great area to interact thus, drug components transported via nanorobots can be benefitted while transferring mass from one location to other

- Method not requiring the introduction of instruments in the body
- Activities are regulated by computer through knobs to modulate quantity, repetitiveness;
- Excelling correctness
- In regions where drug activity is not needed, the drug remains dormant reducing the unwanted adverse effect
- Nanorobots upper limit dimension is three microns, thus effortlessly can move in the body and do not obstruct capillaries
- if produced in large quantity. It is economical, there is a decrease in expenses if produced in bulk, even if primarily expenses are more[18;19]

Disadvantages

- Primary design expenses are more
- It has a sophisticated design the demagnetizing field can be built by electrical systems that may activate bioelectric-based molecular recognition systems
- nanorobots are prone to be affected by electrical disruptions from different sources like demagnetizing fieldsfrom other devices present in vivo
- Terrorists can utilize nanorobots to give mental and physical pain to people as nanorobots can destroy the human body at molecular level
- Secrecy can be an issue with nanorobots[18].

Types of Nanorobots

Therapy for several illnesses related to humans is offered through the proposals of new instruments by medical nanorobotics. The design of several nanorobots involves respirocytes, microbivore, clottocytes, pharmacytes, dentifrobots, and vasculoids .

Chromallocyte (Cell Repair Nanorobot)

These nanorobots may avert the destruction due to uncoordinated blades at the cell stage. Scientists can imitate the human body and restorative important body organs, identical to a natural way of healing, because of components characteristics that are nano-sized. Because of nanorobotics, nanobots, nanites, etc it is feasible to fabricate the several sophisticated components which make the robots.

Clottocytes (Artificial Mechanical Platelets)

The developing field of nanotechnology has possibilities to create metallic nanoparticles that can accomplish to stop bleeding in just about 1 second in comparison to the blood coagulation process to constrict blood vessels and cease bleeding which takes about two to five minutes. Clottocyte or artificial mechanical platelet is designed by dr. Robert frietas jr in theory which has a rounded shape identical to platelets in dimensions occurring in humans that is two microns in diameter.

Dentifrobots (Dental Nanorobots)

Nanorobot dentifrices wrap up subgingival surfaces in the mouth when given in mouthwash or dental cream and can assimilate captured food matter into nontoxic and non-odorous vapors. Dentifrobots when correctly set up can recognize and kill disease-causing bacteria that happen to be present in plaque or other parts. These small bots are mechanical machines and get decommissioned on ingestion.

Microbivores (Artificial Mechanical White Cells)

These are spherical structures with squashed ends, assembled, mechanical phagocytes with a 3.5-micron diameter. Which create an artificial immunity system when brought into blood circulation. It recognizes the disease-causing microbes and blood toxins and ravages them. By utilizing various kinds of chambers such as morcellation, digestion port, exhaustion chambers, and robotic grapples, the microbivores work.

Pharmacytes (Nanorobotic Pharmaceutical Drug Delivery)

These nanobots are created for delivering drugs. The payload part of the pharmacyte consists of the drug. To the particular cellular sites, pharmacytes will be able to exactly transit and targeted a smart supply of the drug. Upon reaching in the proximity of cancer cells or other cells of the target, pharmacyte delivers the drug through nano injection or via continuous penetration in the cytoplasm until the drug is delivered.

Respirocyte (Artificial Mechanical Red Cells)

These act as artificial cells and transport oxygen and carbon dioxide in the human body. Respirocytes imitate red blood cells as well as kill the microbes. One and a half billion oxygen molecules can be stocked by these nanorobots accessible to tissues majorly. Alterations in surroundings are recognizable by respirocytes by sensors available on their surface and modulate the input and output of gases by nanocomputers.

Vasculoids (Artificial Nanomechanical Vascular System)

It reinstates and broadens the vascular system and is known as a vascular machine. Vasculoid is not just a synthetic vascular system, but also it is part of a class of space or volume adding nanomedical enhancement instruments whose function applies to the human vascular tree. Vasculoids can take part in every transfer involved in the vascular system such as gases, cytokines, cell particulars, glucose, hormones, etc . Table 2 lists the nanoproducts and their remarks[2][3].

VI. CONCLUSION

Nanorobots are an emerging field of research and technology that involve the development and utilization of tiny robots at the nanoscale level. These nanorobots hold great potential in various applications, including medicine, manufacturing, environmental remediation, and information technology. In the field of medicine, nanorobots offer exciting possibilities for targeted drug delivery, minimally invasive surgeries, and disease diagnosis. They can navigate through the human body, deliver medication to specific sites, and perform precise tasks, such as removing blockages or repairing damaged tissues. In manufacturing, nanorobots have the potential to revolutionize production processes by enabling precise control and manipulation of materials at the atomic and molecular levels. This could lead to enhanced efficiency, improved product quality, and the development of new materials with unique properties.

In environmental remediation, nanorobots could be used to detect and remove pollutants from the environment, contributing to the cleanup of contaminated sites and the preservation of ecosystems.

In information technology, nanorobots could be utilized for data storage, computation, and communication. Their small size and high computing power could lead to significant advancements in the field of electronics and data processing
Although nanorobots hold immense promise, there are still challenges to overcome, including their controlled movement, power source, biocompatibility, and ensuring their safe integration into existing systems. In conclusion, nanorobots offer a wide range of potential applications across various industries. Continued research and development in this field have the potential to revolutionize medicine, manufacturing, environmental remediation, and information technology, leading to significant advancements in our daily lives and society as a whole.

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