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**“NANOTECHNOLOGY”**

# Anti-HIV using Nanorobots

**ABSTRACT:**

Nanorobots are nanodevices that will be used for the purpose of maintaining and protecting the human body against pathogens. Nano is one billionth of one. Nanotechnology is the technology in which the operations are performed on nanometrics. It is the application of different technologies primarily interested in the reduction of size.

The credential part of this paper gives the theoretical application of nanodevices in the treatment of AIDS. There is no technology for the treatment of AIDS. Some of the drugs of specific composition are given to the patients depending on the intensity of the disease. The drugs using nowadays are able to increase the lifetime to a few years only. To make the treatment more specific, we use the nanodevices that use nanosensors to sense the AIDS infected WBC's. In this we are using nanorobots to get back the HIV infected WBC's. By doing so constant levels of WBC's are maintained in the blood stream. Thus the AIDS patient is provided with the immune system so that he can defend himself from diseases.

In this paper only a theoretical analysis is given and all the information provided are specifically organized by us .In India more than 50 lakhs of people are infected by this dreaded disease and it constitutes 10% of the total infected. We are doing research on this paper and we hope that this theoretical approach can be made practical in the near future, so that the killer disease AIDS could also be made in control on the hands of Human with the emerging new technology like NANOTECHONOLGY which has a Bio-medical Application.

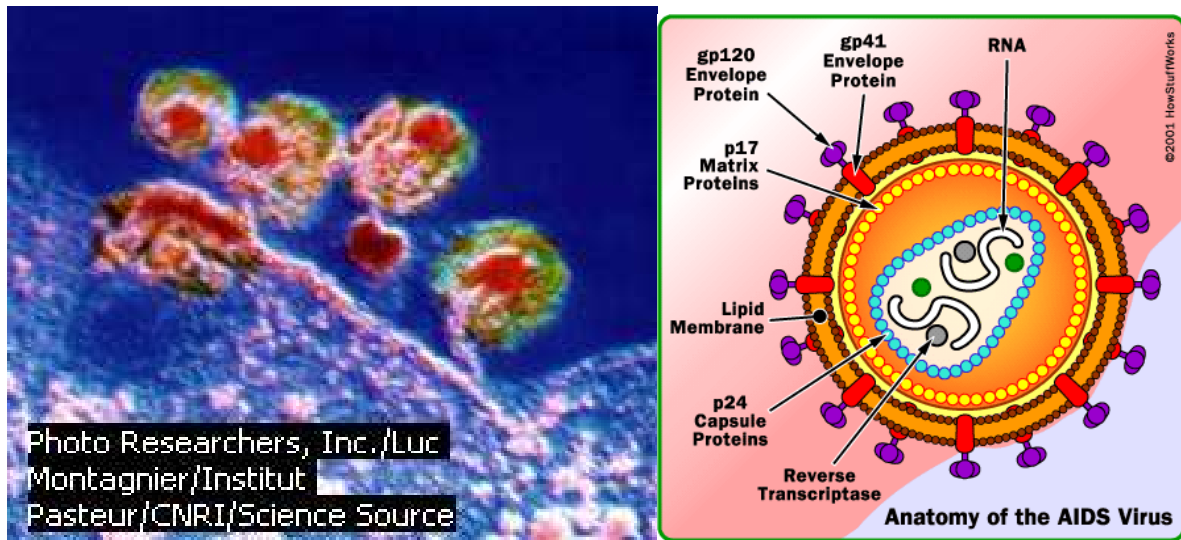
## INTRODUCTION:

### AIDS:

Acquired Immunodeficiency Syndrome (AIDS), human viral disease that ravages the immune system, undermining the body's ability to defend itself from infection and disease. Caused by the human immunodeficiency virus (HIV), AIDS leaves an infected person vulnerable to opportunistic infections. Such infections are harmless in healthy people, but in those whose immune systems have been greatly weakened, they can prove fatal. Our paper aims at the removal of the virus from the RNA of the body using the nanorobots.

### HIV : Human Immunodeficiency Virus

The human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), principally attacks CD4 T-cells, a vital part of the human immune system. As a result, the body's ability to resist opportunistic viral, bacterial, fungal, protozoal, and other infection is greatly weakened. *Pneumocystis carinii* pneumonia is the leading cause of death among people with HIV infection, but the incidence of certain types of cancers such as B-cell lymphomas and Kaposi's sarcoma is also increased. Neurological complications and dramatic weight loss, or "wasting," are characteristic of endstage HIV disease (AIDS). HIV can be transmitted sexually; through contact with contaminated blood, tissue, or needles; and from mother to child during birth or breastfeeding. Full-blown symptoms of AIDS may not develop for more than 10 years after infection.



## **NANOTECHNOLOGY:**

Nano is one billionth of one. Now we have the so-called microprocessors and microarray technology that would reach the nano level within a few decades, we suppose. Some call this technology to be nanotechnology and some others name it the molecular nanotechnology, to be specific.

## **REASONS FOR APPLYING NANOTECH TO BIOLOGICAL SYSTEMS:**

Most animal cells are 10,000 to 20,000 nanometers in diameter. This means that nanoscale devices (having at least one dimension less than 100 nanometers) can enter cells and the organelles inside them to interact with DNA and proteins. Tools developed through nanotechnology may be able to detect disease in a very small amount of cells or tissue. They may also be able to enter and monitor cells within a living body. Miniaturization will allow the tools for many different tests to be situated together on the same small device. This means that nanotechnology could make it possible to run many diagnostic tests simultaneously as well as with more sensitivity. In general, nanotechnology may offer a faster and more efficient means for us to do much of what we do now

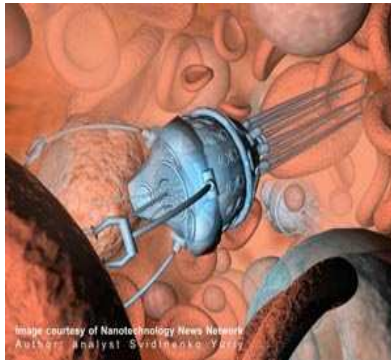
## **NANOMEDICINE:**

The emerging field of nanorobotics is aimed at overcoming the shortcomings present in the traditional way of treatment of patients. Our bodies are filled with intricate, active molecular structures. When those structures are damaged, health suffers. Modern medicine can affect the work of the body in many ways, but from a molecular viewpoint it remains crude. Molecular manufacturing can construct a range of medical instruments and devices with greater abilities. The human body can be seen as a workyard, construction site, and battleground for molecular machines. It works remarkably well; using systems so complex that medical science still doesn't understand many of them.

## **BIOMEDICAL APPLICATIONS OF NANOROBOTS:**

The enormous potential in the biomedical capabilities of nanorobots and the imprecision and side effects of medical treatments today make nanorobots very desirable. But today, in this revolutionary era we propose for nanomedical robots, since they will have no difficulty in identifying the target site cells even at the very early stages which cannot be done in the traditional treatment and will ultimately be able to track them down and destroy them wherever they may be growing. By having these Robots, we can refine the treatment of diseases by using biomedical, nanotechnological engineering.

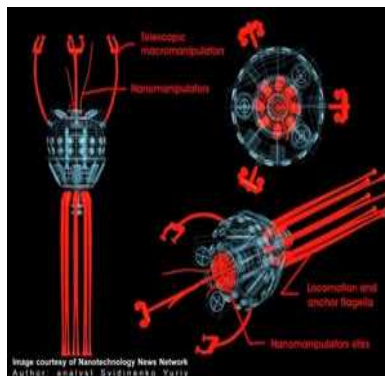
### Nanorobot designed to perform cell surgery



### WHAT IS A MEDICINAL NANOROBOT ?

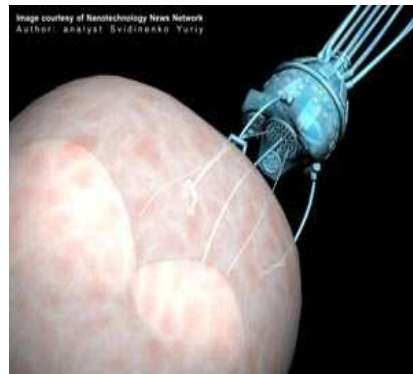
Nanorobots are theoretical microscopic devices measured on the scale of nanometers (1 nm equals one millionth of a millimeter). When fully realized from the hypothetical stage, they would work at the atomic, molecular and cellular level to perform tasks in both the medical and industrial fields that have heretofore been the stuff of science fiction. Nanomedicine's nanorobots are so tiny that they can easily traverse the human body. Scientists report the exterior of a nanorobot will likely be constructed of carbon atoms in a diamondoid structure because of its inert properties and strength. Super-smooth surfaces will lessen the likelihood of triggering the body's immune system, allowing the nanorobots to go about their business unimpeded. Glucose or natural body sugars and oxygen might be a source for propulsion, and the nanorobot will have other biochemical or molecular parts depending on its task.

### Nanorobot in Nanoscale



According to current theories, nanorobots will possess at least rudimentary two-way communication; will respond to acoustic signals; and will be able to receive power or even re-programming instructions from an external source via sound waves. A network of special stationary nanorobots might be strategically positioned throughout the body, logging each active nanorobot as it passes, then reporting those results, allowing an interface to keep track of all of the devices in the body. A doctor could not only monitor a patient's progress but change the instructions of the nanorobots in vivo to progress to another stage of healing. When the task is completed, the nanorobots would be flushed from the body.

### Nanorobot performing operations on blood cells



Nanorobotic phagocytes called microbivores could patrol the bloodstream, seeking out and digesting unwanted pathogens including bacteria, viruses or fungi. Each nanorobot could completely destroy one pathogen in just 30 seconds - about 100 times faster than natural leukocytes or macrophages - releasing a harmless effluent of amino acids, mononucleotides, fatty acids and sugars. No matter that a bacterium has acquired multiple drug resistance to antibiotics or to any other traditional treatment. The microbivore will eat it anyway, achieving complete clearance of even the most severe septicemic infections in minutes to hours, as compared to weeks or even months for antibiotic-assisted natural phagocytic defenses, without increasing the risk of sepsis or septic shock. Related nanorobots could be programmed to recognize and digest cancer cells, or to clear circulatory obstructions within minutes in order to rescue stroke patients from ischemic damage.

More sophisticated medical nanorobots will be able to intervene at the cellular level, performing surgery within cells. Physician-controlled nanorobots could extract existing chromosomes from a diseased cell and insert newly manufactured ones in their place, a process called chromosome replacement therapy. This would allow a permanent cure of any pre-existing genetic disease, and permit cancerous cells to be reprogrammed to a healthy state

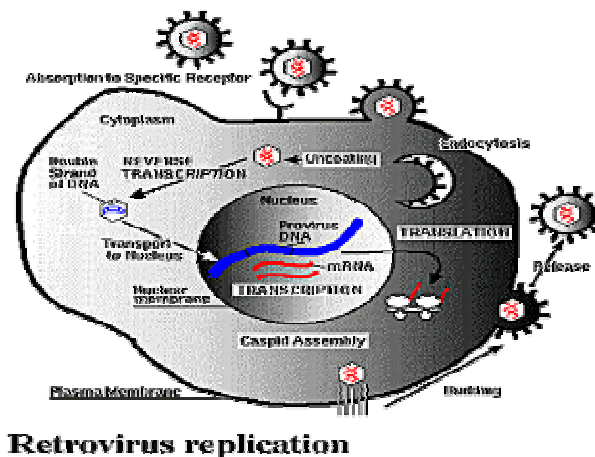
#### **IMPLEMENTATION:**

#### **ANTI - HIV USING NANOTECHNOLOGY:**

#### **AIDS:**

The virus responsible for the condition known as AIDS (Acquired Immunodeficiency Syndrome), is named HIV (Human Immunodeficiency Virus). AIDS is the condition whereby the body's specific defense system against all infectious agents no longer functions properly. There is a focused loss over time of immune cell function, which allows intrusion by several different infectious agents, the result of which is loss of the ability of the body to fight infection and the subsequent acquisition of diseases such as pneumonia.

The immune system is a system within all vertebrates (animals with a backbone) which in general terms, is comprised of two important cell types: the B-cell and the T-cell. The B-cell is responsible for the production of antibodies (proteins which can bind to specific molecular shapes), and the T-cell (two types) is responsible either for helping the B-cell to make antibodies, or for the killing of damaged or "different" cells (all foreign cells except bacteria) within the body. The two main types of T-cells are the "helper" T-cell and the cytotoxic T-cell. The T-helper population is further divided into those which help B-cells (Th2) and those which help cytotoxic T-cells (Th1). Therefore, in order for a B-cell to do its job requires the biochemical help of Th2 helper T-cells; and, for a cytotoxic T-cell to be able to eliminate a damaged cell (say, a virally-infected cell), requires the biochemical help of a Th1 helper T-cell.

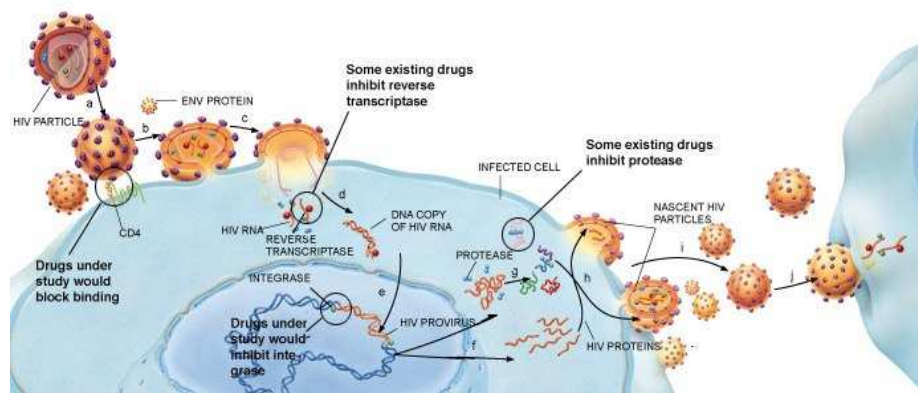


## IMMUNESYSTEM:

Whenever any foreign substance or agent enters our body, the immune system is activated. Both B- and T-cell members respond to the threat, which eventually results in the elimination of the substance or agent from our bodies. If the agent is one which goes inside one of our cells and remains there most of the time (intracellular pathogens like viruses or certain bacteria which require the inside of one of our cells in order to live), the "best" response is the activation of cytotoxic T-cells (circulate in the bloodstream and lymph), which eliminate the agent through killing of the cell which contains the agent (agent is otherwise "hidden"). Both of these kinds of responses (B-cell or cytotoxic T-cell) of course require specific helper T-cell biochemical information as described above. Usually, both B-cell and cytotoxic T-cell responses occur against intracellular agents which provides a two-pronged attack. Normally, these actions are wonderfully protective of us. The effect of HIV on the immune system is the result of a gradual (usually) elimination of the Th1 and Th2 helper T-cell sub-populations.

**OPERATION OF HIV:**

How HIV Specifically Affects the Immune System  
Remember about the proteins, which are part of the envelope of HIV? Well, one of these proteins, named gp 120, (a sugar-containing protein called a glycoprotein, of approximately 120,000 molecular weight), "recognizes" a protein on helper T-cells named CD4, and physically associates with it. The CD4 [Cluster of Differentiation Antigen No. 4] protein is a normal part of a helper (both Th1 and Th2) T-cell's membrane.

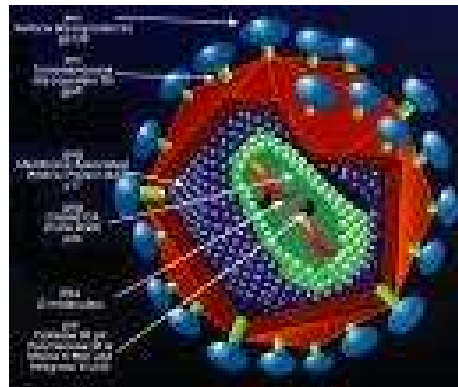
**Method of infection of HIV**

Thus, CD4 is a specific receptor for HIV. This virus however, can also infect other cells which include macrophages and certain other kinds of cells which can engulf substances through a process known as phagocytosis. As a consequence of the interaction with CD4 on helper T-cells, HIV specifically infects the very cells necessary to activate both B-cell and cytotoxic T-cell immune responses. Without helper T-cells, the body cannot make antibodies properly, nor can infected cells containing HIV (an intracellular pathogen) be properly eliminated. Consequently, the virus can: multiply, kill the helper T-cell in which it lives, infect adjacent helper T-cells, repeat the cycle, and on and on, until eventually there is a substantial loss of helper T-cells.

The fight between the virus and the immune system for supremacy is continuous. Our body responds to this onslaught through production of more T-cells, some of which mature to become helper T-cells. The virus eventually infects these targets and eliminates them, too. More T-cells are produced; these too become infected, and are killed by the virus. This fight may continue for up to ten years before the body eventually succumbs, apparently because of the inability to any-longer produce T-cells. This loss of helper T-cells finally results in the complete inability of our body to ward-off even the weakest of organisms (all kinds of bacteria and viruses other than HIV) which are normally not ever a problem to us. This acquired condition of immunodeficiency is called, AIDS.



**Structure of AIDS virus**



**METHODOLOGY:**

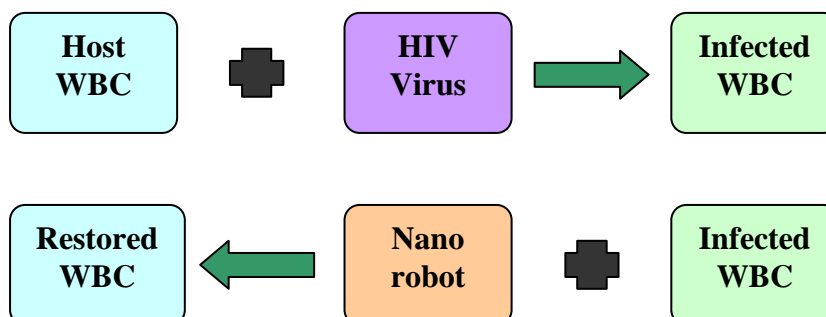
AIDS by itself is not a killer disease. The cause of AIDS is the HIV virus that is capable of destroying the immune system. Thereby the host system is vulnerable to small diseases which will turn into a fatal one but actually it is not a fatal disease. The HIV virus attack the WBC's by converting them into the HIV. Thereby all the WBC's are converted into HIV, so the immune system will fail. This is the reason for the death of the patient. Our idea is to convert the AIDS affected WBC's back into the original form of the WBC by using a Nanorobot, thereby the patient is made to have a constant amount of immune system. Nanorobot performs the inverse process of the HIV.

**CONVERSION RATE:**

The HIV convert the WBC in a faster manner .So the conversion by the A-HIV Nanorobot should also be very much faster than that of the HIV, so that a constant level of WBC's are maintained in the blood stream. Because of this ,an AIDS patient can defend himself from various diseases .The conversion rate should be at least five times greater than that of the HIV conversion rate.

**BASIC EQUATION:**

The basic equation for the conversion of the HIV infected WBC's back to its original form is given below. The host system is the WBC and is converted by the HIV into an infected WBC. This is the reason for AIDS.



### **CREATION OF NANO DEVICES:**

The creation of the nano devices can be done using any of the two techniques that are available. They are

- Top-down approach
- Bottom-up approach

### **CHALLENGES FACED BY NANOROBOTS:**

While designing nanorobots in nanoscale dimensions there should be a better understanding of how matter behaves on this small scale. Matter behaves differently on the nanoscale than it does at larger levels. So the behaviour of the nanorobots must be taken care so that they do not affect us both inside and outside the body.

Other challenges apply specifically to the use of nanostructures within biological systems. Nanostructures can be so small that the body may clear them too rapidly for them to be effective in detection or imaging. Larger nanoparticles may accumulate in vital organs, creating a toxicity problem. So we need to consider these factors as they anticipate how nanostructures will behave in the human body and attempt to create devices the body will accept.

### **DESIGN OF NANOROBOTS:**

The nanorobots that we describe here will be floating freely inside the body exploring and detecting the HIV virus. So, while designing such a nanorobot for AIDS treatment, the main factors that are to be considered are given below.

### **TECHNIQUE USED:**

We use the bottom-up approach, which involves assembling structures atom-by-atom or molecule-by-molecule which will be useful in manufacturing devices used in medicine.

### **SIZE:**

Nanorobots will typically be .5 to 3 microns large with 1-100 nm parts. Three microns is the upper limit of any nanorobot because nanorobots of larger size will block capillary flow.

### **STRUCTURE:**

The nanorobot's structure will have two spaces that are

#### **Interior:**

It will be a closed, vacuum environment into which liquids from the outside cannot normally enter unless it is needed for chemical analysis.

#### **Exterior:**

It will be subjected to various chemical liquids in our bodies.

### **CHEMICAL ELEMENTS:**

Carbon will likely be the principal element comprising the bulk of a medical nanorobot, probably in the form of diamond or diamondoid/fullerene nanocomposites largely because of the tremendous strength and chemical inertness of diamond. Many other light elements such as hydrogen, sulfur, oxygen, nitrogen, fluorine, silicon, etc. may also be used

**ABILITY TO DEFEND FROM IMMUNE SYSTEM:**

Immune system response is primarily a reaction to a "foreign" surface.. Passive diamond exteriors may turn out to be ideal. Several experimental studies hint that the smoother and more flawless the diamond surface, the less leukocyte activity and the less fibrinogen adsorption we will get. So it seems reasonable to hope that when diamond coatings can be laid down with almost flawless atomic precision, making nanorobot exterior surfaces with near-nanometer smoothness that these surfaces may have very low bioactivity. Due to the extremely high surface energy of the passivated diamond surface and the strong hydrophobicity of the diamond surface, the diamond exterior is almost completely chemically inert and so opsonization should be minimized. If flawless diamond surfaces alone do not prove fully bioinactive as hoped, active surface management of the nanorobot exterior can be used to ensure complete nanodevice biocompatibility. Allergic and shock reactions are similarly easily avoided.

**ACQUIRING POWER:**

It could metabolize local glucose and oxygen for energy. Another possibility is externally supplied acoustic power, which is probably most appropriate in a clinical setting. There are literally dozens of useful power sources that are potentially available in the human body.

**COMMUNICATON:**

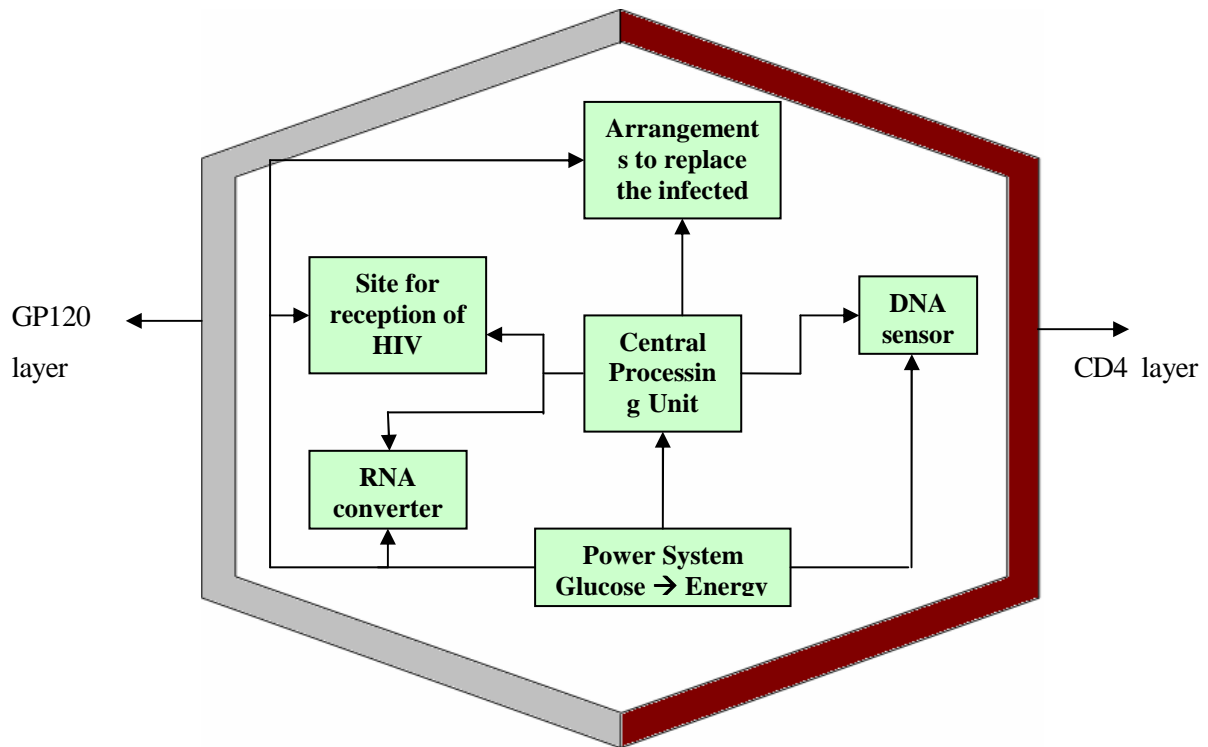
Having nanorobots inside the body it is very essential to know the actions done by it. There are many different ways to do this. One of the simplest ways to send broadcast-type messages into the body, to be received by nanorobots, is acoustic messaging. A device similar to an ultrasound probe would encode messages on acoustic carrier waves at frequencies between 1-10 MHz.

**TRACKING:**

A navigational network may be installed in the body, with stationkeeping navigational elements providing high positional accuracy to all passing nanorobots that interrogate them, wanting to know their location. Physical positions can be reported continuously using an in vivo communications network.

**STRUCTURE OF NANOROBOT:**

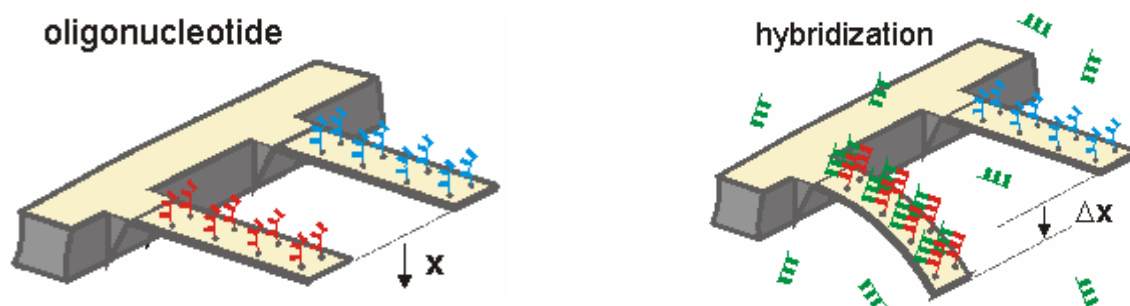
The nanorobot consists of three main parts like the DNA sensor,CPU,RNA converter and the power system.The purpose of DNA sensor is to identify the HIV infected cell.The RNA converter is used to change the RNA of the HIV.The CPU controls all the activities .The power system provides the necessary energy for the working of the nanorobot.



**COMPONENTS OF NANOROBOT:**

**DNA SENSOR:**

The DNA sensor is an cantilever type. In one arm the actual sample is placed and in the second arm the sample from the WBC is placed. Even if the samples differ by a single base, it can be identified. The structure is given below.



Carbon nanotube network field-effect transistors (NTNFETs) that function as selective detectors of DNA immobilization and hybridization. NTNFETs with immobilized synthetic oligonucleotides have been shown to specifically recognize target DNA sequences, including H63D single-nucleotide polymorphism (SNP) discrimination in the HFE gene, responsible for hereditary hemochromatosis. The electronic responses of NTNFETs upon single-stranded DNA immobilization and subsequent DNA hybridization events were confirmed by using fluorescence-labeled

oligonucleotides and then were further explored for label-free DNA detection at picomolar to micromolar concentrations

**POWER SYSTEM:**

The nanorobot uses the glucose molecules present in the human body as the power source. The conversion of this glucose molecule into the energy is accomplished by the energy converter, which is an important part of the nanorobot.

**REQUIREMENTS OF THE NANOROBOT:**

1. It should be very small so that the blood capillary flow is not affected.
2. It should not be affected by the WBC.
3. It should be capable of sensing the HIV infected WBC only and its action is restricted to the infected WBC only.
4. It should make its operations in the RNA to convert back to the original DNA of the WBC by suitably changing the bases like the adenine, guanine.
5. It should convert the infected WBC into the original WBC in a very faster manner.
6. It should be made of cheaper rates, so that the patient can afford it easily.

**OPERATION:**

The designed anti-HIV nanorobots are injected into the blood stream. These nanorobots continue the process of conversion in the bone marrow, blood and in the thymus glands where the concentration of the WBC's are more. This process takes place till the normal death of the patient.

**ADVANTAGES:**

1. More than million people in this world are affected by this dreaded disease. Currently there is no permanent vaccine or medicine available to cure the disease. The currently available drugs can increase the patient's life to a few years only, so the invention of this nanorobot will make the patients get rid of the disease.
2. As the nanorobot does not generate any harmful activities there is no side effect. It operates at specific sites only.
3. The initial cost of development is only high but the manufacturing by batch processing reduces the cost.

**DISADVANTAGES:**

1. The nanorobot should be very accurate, otherwise harmful effects may occur.
2. The initial design cost is very high.
3. The design of this nanorobot is a very complicated one

**CONCLUSION:**

The paper is just a theoretical justification. But the recent advancement in the field of nanotechnology gives the hope of the effective use of this technology in medical field. This paper starts by giving an introduction to nanorobots and its importance as recognized by various other technocrats. This is the beginning of nanoera and we could expect further improvements such as a medicine to AIDS using nanotechnology .

**Reference:**

**[www.technicalpapers.co.nr](http://www.technicalpapers.co.nr)**