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**Ethics of Nanotechnology (Nano-Robotics)**

Dear Dr. Ibeh,

I am pleased to submit the final report of my ethics paper on the topic: Ethics of Nanotechnology.

The objective of this report is to create awareness that nano-robotics real and developments are being made. And that the step into this cutting a technology “nano-robotics”, could solve most problems in the world today, as well as creating or posing corrosive danger to the environment if not managed carefully.

I believe this paper will meet your standards and surely will explain the main point of the topic.

Sincerely,

Ugochukwu Nwagwu

# **Ethics of Nanotechnology (Nano-Robotics)**

BY

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## **Abstract**

A world where things can be assembled molecule-by-molecule and things can also disassembled and turned into a totally different thing. Where people can be operated on and healed by cell-sized robots. Imagine that, yes I know it might total sound like science fiction in a movie, well, guess what, it is not, science is going ahead of itself. Tremendous developments are being made now.

With nano-robots having the ability of manipulating matter, we should go through the exercise of formulating solutions to potential ethical issues before the technology is irreversibly adopted by society. We must examine the ethics of developing nanotechnology and create policies that will aid in its development so as to eliminate or at least minimize its damaging effects on society.

## **Introduction**

### **What is nanotechnology?**

Nanotechnology, also called molecular manufacturing, is a branch of engineering that deals with the design and manufacture of extremely small electronic circuits and mechanical devices built at the molecular level of matter. The goal of nanotechnology is to be able to manipulate materials at the atomic level to build the smallest possible electromechanical devices called **nano-robots**, given the physical limitations of matter. Much of the mechanical systems we know how to build will be transferred to the molecular level as some atomic analogy.

In essence, the purpose of developing nanotechnology is to have tools to work on the molecular level analogous to the tools we have at the macroworld level. Like the robots we use to build cars and the construction equipment we use to build skyscrapers, nano-robots will enable us to create a plethora of goods as well as to increase our engineering abilities to the limits of the physical world.

## **Literature Review**

With current semiconductor chip manufacturing encroaching upon the nanometer scale and the ability to move individual atoms at the IBM Almaden laboratory, we are fast approaching the technological ability to fabricate productive nano-robots that can manipulate things at the atomic level. From this ability we will be able to develop molecular-sized computers and robots, which would give us unprecedented control over matter and the ability to shape the physical world as we see fit. Some may see it as pure fantasy, but others speculate that it is an inevitability that will be the beginning of the next technological revolution.

Laboratories, such as the Stanford Nanofabrication Facility (SNF), have already been researching nanofabrication techniques with applications in fiber optics, biotechnology, microelectromechanical systems (MEMS), and wide variety of other research fields relevant to today's technology. MEMS, "tiny mechanical devices such as sensors, valves, gears, mirrors, and actuators embedded in semiconductor chips", are particularly interesting because they are but a mere step away from the molecular machines envisioned by nanotechnology. MEMS are already being used in automobile airbag systems as accelerometers to detect collisions and will become an increasing part of our everyday technology.

### **Advantages of nano-robotics**

To imagine disassemblers dismantling garbage to be recycled at the molecular level, and then given to assemblers for them to build atomically perfect engines, don't

sound like a bad idea in this world of ours. Stretching this vision a bit, you can imagine a nano-robot which could reassemble matter in the form of a juicy steak, given the correct blueprints and organization of these nano-robots.

With nano-robots, we could better design and synthesize pharmaceuticals; we could directly treat diseased cells like cancer; we could better monitor the life signs of a patient; or we could use nano-robots to make microscopic repairs in hard-to-operate-on areas of the body. With regard to the environment, we could use nano-robots to clean up toxins or oil spills, recycle all garbage, and eliminate landfills, thus reducing our natural resource consumption.

### **Disadvantages of nanotechnology**

The flip side to these benefits is the possibility of assemblers and disassemblers being used to create weapons or being used as weapons themselves, or for them to run wild and wreak havoc. Weapons are an obvious negative use of nanotechnology. Simply extending today's weapon capabilities by miniaturizing guns, explosives, and electronic components of missiles would be deadly enough. However, with nanotechnology, armies could also develop disassemblers to attack physical structures or even biological organisms at the molecular level. A similar hazard would be if general purpose disassemblers got loose in the environment and started disassembling every molecule they encountered. This is known as "The Gray Goo Scenario." Furthermore, if nano-robots were created to be self replicating and there was a problem with their limiting mechanism, they would multiply endlessly like viruses. Even without considering the extreme disaster scenarios of nanotechnology, we can find plenty of potentially harmful

uses for it. It could be used to erode our freedom and privacy; people could use molecular sized microphones, cameras, and homing beacons to monitor and track others.

### **Ethical issues**

Society feels that Nanotechnology will give us more "god-like" powers which might lead to disaster. And might also, lead to an undetectable surveillance, Right to privacy could be jeopardized.

### **Conclusion**

It would be difficult to deny the potential benefits of nanotechnology and stop development of research related to it since it has already begun to penetrate many different fields of research. However, nanotechnology can be developed using guidelines to insure that the technology does not become too potentially harmful. As with any new technology, it is impossible to stop every well funded organization who may seek to develop the technology for harmful purposes. However, if the researchers in this field put together an ethical set of guidelines (e.g., Molecular Nanotechnology Guidelines<sup>6</sup>) and follow them, then we should be able to develop nanotechnology safely while still reaping its promised benefits.

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