

# Cyborgs: Machine in Disguise?

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**Abstract-** *Cybernetic organism have both organic and bio mechanized body element. This paper highlights the difference between a cyborg and an android. What actual attempts of cyborgization look like in reality and how cyborgization has brought or is bringing changes in various fields (Cyborg Olympics, Rob Spence Case, C-Leg system, etc). Also what future holds and look like with advancement in cyborgization. The future of cyborgs is filled with exciting possibilities. We currently have the technology to potentially restore a human body functionality but in future it will be possible to enhance the human body functionality.*

## Introduction

The word cyborg is short form for cybernetic organism. Cyborg is a being with both organic and bio-mechatronic body elements.

In science fiction, the most recognizable portrayal of a cyborg is a human being with visibly mechanical parts, such as **Alita or Motorball players in Battle Angel Alita** or **Cyborg** from **D.C Comics** or **The Borg** from **Star Trek**. More human appearing cyborgs may cover up their mechanical parts such as **Darth Vader** from **Star Wars**. On the other hand characters like **Murphy** from **RoboCop** and **Motoko Kusanagi** from **Ghost in the Shell** are full body cyborg. In the examples mentioned above as well as many more, it is common for cyborgs to have physical or mental abilities beyond what humans are capable of. In fictional world some cyborgs have super strength, computer assisted brain, or built in weaponry.



Fig 1-D.C Comics Cyborg

According to the definition of cyborg, a human with an artificial cardiac pacemaker or implantable cardioverter-defibrillator would be considered as a cyborg, since these devices measure voltage potentials in the body, perform signal process, and may deliver electrical stimuli, mistreatment this artificial feedback mechanism to keep that person alive. Also using contact lenses or hearing aids can be consider as modifications to enhance human biological capabilities.

## Difference between Cyborg and Android

Androids and cyborgs are staple figures in fantasy movies and television shows and are being pictured as human robots. But so as to spot whether it's an android or a cyborg, we need to point out the individual differences between these two-

- An Android is a robot that resembles a human being while a cyborg is an organism that is partly organic and partly machine.
- Androids have largely been the domain of fantasy while cyborgs, within the strict sense of the word, have long been alive.
- Androids are specific to robots in human form while cyborgs are often animals.
- Androids are not living beings while cyborgs are.

## Cyborg tissues in Engineering

Cyborg tissues structured with carbon nanotubes and plant or fungus cells are employed in artificial tissue engineering to provide new materials for mechanical and electrical uses.

The work was presented by **Di Giacomo and Maresca at MRS 2013 Spring conference on April 3<sup>rd</sup>, talk number SS4.04**. The cyborg obtained was inexpensive, light and had unique mechanical properties. It could also be shaped in desired forms. Cells combined with MWCNTs(Multi-walled carbon nanotubes) co-precipitated with a specific aggregate of cells and nanotubes that formed a viscous material.

Likewise, dried cells still acted as a stable matrix for the MWCNT network. When ascertained by optical research the fabric resembled a synthetic "tissue" composed of solely blood cells. The result of cell drying is manifested by their "ghost cell" look. A rather specific physical interaction between MWCNTs and cells was ascertained by microscopy suggesting that the semipermeable membrane (the most outer part of fungus and plant cells) could play a major active role in establishing a CNTs network and its stabilization. This novel material is often employed in a good variety of electronic applications from heating to sensing and has the potential to open necessary new avenues to be exploited in magnetism shielding for frequency physics and region technology.

In particular using *Candida albicans* cells cyborg tissue materials with temperature sensing properties have been reported.

### Actual cyborgization attempts

In current prosthetic application, the C-Leg system developed by Otto Bock HealthCare is employed to exchange a person's leg that has been amputated due to injury or illness. In vision science, brain implants have been used to treat acquired blindness.

In 1997, Philip Kennedy, a scientist and physician, created the world's first human cyborg from Johnny Ray, a Vietnam veteran who suffered a stroke. Kennedy embedded an implant he designed (and named "neurotrophic electrode") near the part of Ray's brain so that Ray would be able to have some movement back in his body. The surgery went successfully, but in 2002, Johnny Ray died.



**Fig 3**-Kevin Warwick with his wife

In contrast to replacement technologies, in 2002, under the heading Project Cyborg, a British scientist, Kevin Warwick had an array of 100 electrodes fired into his nervous system in order to link his nervous system to the internet to investigate enhancement possibilities. Warwick successfully carried out a series of experiments including extending his nervous system over the internet to control a robotic hand. Subsequently, he investigated ultrasonic input in order to remotely detect the distance between objects. Finally, with electrodes also implanted into his wife's systema nervosum, they conducted the primary direct transmission experiment between the nervous systems of two humans.

Since 2004, British artist Neil Harbisson has had a cyborg antenna implanted into his head that allows him to extend his perception of colors beyond the



**Fig 2**-Neil Harbisson

human visual spectrum through vibrations in his skull. His antenna was included within his 2004 passport photograph which has been claimed to confirm his cyborg status. In 2012 at TEDGlobal, Harbisson explained that he began to feel cyborg when he noticed that the software and his brain had united and given him an additional sense.

Neil Harbisson is a co-founder of the Cyborg Foundation(2004) and cofounded the Transpecies Society in 2017, which is an association that empowers the individuals with non-human identities and supports them in their decisions to develop unique senses and new organs. Neil Harbisson may be a global advocate for the rights of cyborgs.

## Animal cyborg

The US-based company Backyard Brains released the world's first commercially available cyborg called RoboRoach. RoboRoach is a kit that allows its user to momentarily control the movements of a cockroach via bluetooth enabled smartphone as the controller. The kit was officially released in TED talk at TED Global conference in 2013.

## Cyborg in medicine

In medicine, there are two important types of cyborg:- Restorative and Enhanced. As the name suggest restorative cyborgs are used to restore lost function, organ and limbs. The aim of restorative cyborgization is to repair the broken or missing processes to revert to a healthy or near normal level of function.

On the other hand enhanced cyborg focuses on maximizing the output and minimizing the input. Thus, the enhanced cyborg intends to exceed normal processes or even gain new functionalities that weren't originally present.

Rob Spence, a Toronto based film maker, who severely damaged his right eye in a shooting accident on his grandfather's farm as a child. Spence contacted Steve Mann at MIT, an expert in wearable computing and cyborg technology. Under Mann's Guidance, Spence created a miniature camera which could be fitted inside his prosthetic eye. This bionic eye is capable of recording everything he sees and contains a 1.5 mm-square, low-resolution video camera, a small round printed circuit board, a wireless video transmitter, which allows him to transmit what he sees in real time to a computer, and a 3-voltage rechargeable battery.

Retinal implants are another sort of cyborgization in medicine. The theory behind retinal stimulation to restore vision to people suffering from retinitis pigmentosa and vision loss due to aging is that the retinal implant and electrical stimulation would act as a substitute for the missing ganglion cells.

A similar process has been created to aide people who have lost their vocal cords. This experimental device would do away with previously used robotic sounding voice simulators. The transmission of sound would start with a surgery to redirect the nerve that controls the voice and sound production to a muscle within the neck, where a nearby sensor would be able to pick up its electrical signals. The signals would then move to a processor which might control the timing and pitch of a voice simulator. That simulator would then vibrate producing a multitone sound which might be shaped into words by the mouth.

## Cyborg in sports

In 2016 the primary cyborg Olympics were celebrated in Zurich Switzerland. Cybathlon 2016 were the primary Olympics for cyborgs and therefore the first worldwide and official celebration of cyborg



**Fig 4-**People with spinal injuries racing bikes with the help of electric stimulation

sports. In this event, 16 teams of individuals with disabilities used technological developments to show themselves into cyborg athletes. There were six different events. The participants or the competitors used and controlled advanced technologies like powered prosthetic legs and arms, robotic exoskeletons, bikes and motorized wheelchairs.

On one hand this depicted an interesting improvement, as it allowed disabled people to compete and show the several technological enhancements that are already making a difference, on the other hand it brought into forefront that there is still a long way to go. For instance, the exoskeleton race still required its participants to stand up from a chair and sit down, navigate a slalom(a ski race) and other simple activities such as walk over stepping stones and climb up and down stairs. Despite the simplicity of these activities, 8 of the 16 teams that participated within the event dropped off before the beginning.

Nevertheless, one of the goals of such events or activities is to point out how technological enhancements and advanced prosthetics can make a difference in people's lives. The next Cybathlon is expected to occur in 2020.

### Cyborg in space

Sending humans to space may be a dangerous task during which the implementation of varied cyborg technologies might be utilized in the longer term for risk mitigation. Stephen Hawking, a renowned physicist, stated "Life on Earth is at the ever-increasing risk of being wiped out by a disaster such as sudden global warming, nuclear war... I think the humanity has no future if it doesn't enter space." The difficulties associated with space travel could mean that it might take centuries before humans ever become a multi-planet species. There are many effects of spaceflight on the physical body. One major issue of space exploration is the biological need for oxygen. If this necessity was taken out of the equation, space exploration would be revolutionized. A theory proposed by Manfred E. Clynes and Nathan S. Kline is aimed at tackling this problem. The two scientists theorized that the use of an inverse fuel cell that is "capable of reducing CO<sub>2</sub> to its components with removal of the carbon and re-circulation of the oxygen..." could make breathing unnecessary. Another prominent issue is radiation exposure. Yearly, the typical human on earth is exposed to approximately 0.30 rem of radiation, while an astronaut aboard the International Space Station for 90 days is exposed to 9 rem. To tackle the matter, Clynes and Kline



**Fig 5-**Hugh Herr at TED Talk in March 30,

2018 theorized a cyborg containing a sensor that would detect radiation levels and a Rose osmotic pump "which would automatically inject protective pharmaceuticals in appropriate doses." Experiments injecting these protective pharmaceuticals into monkeys have shown positive results in increasing radiation resistance. Although the effects of spaceflight on our body is an important issue, the advancement of propulsion technology is just as important. With our current technology, it might take us about 260 days to urge to Mars. A study backed by NASA proposes an interesting way to tackle this issue through deep sleep, or torpor. With this technique, it would "reduce astronauts' metabolic functions with existing medical procedures". So far experiments have only resulted in patients being in torpor state for one week. Advancements to permit for extended states of deep sleep would lower the value of the trip to Mars as a result of reduced astronaut resource consumption.

### The Future Scope and Regulation of Implantable Technologies

The future of cyborgs is filled with exciting possibilities. We currently have the technology to potentially restore a human body functionality but in future it is possible that we will be able to enhance the human body functionality. Researchers like Hugh Herr, an American rock climber, engineer and biophysicist created PowerFoot BiOM, the first lower leg system to use robotics to replace muscle and tendon function. The device actually propelled the user forward with each step, within the manner of organic muscle. For propulsion, the BiOM relied on a custom-built carbon-fiber spring—each time the user stepped down on the device, the spring was loaded with potential energy. On the up-step, that energy was supplemented with a battery-powered motor. But since all steps are not same: Scrambling up a steep slope requires a very different gait—and very different parts of the body—from walking across a tennis court. So Hugh Herr and his team developed a proprietary algorithm that measured the angle and speed of the initial heel strike of the BiOM, and controlled, via the microprocessors, the speed and angle of descent on the subsequent step. Most researchers also agree that it is important to develop a sound ethical guidelines for the use of bionics.

On contrary humans are risking their privacy in exchange of enhancement of their body functionalities. Since all of these prosthetics are electronic so these can be hacked or can be used to spy on the people or to intervene in a person's private life. This all can have huge security concern.



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