

CYBORGS: Reinvention of nature

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Abstract

Humans have limited capabilities. Can we use technology to upgrade humans? The possibility exists to enhance human capabilities, to harness the ever increasing abilities of machine intelligence, to enable extra sensory input and to communicate in a much richer way. From its inception as a technology, neural networks have promised to revolutionize the way. We interact with our computers and each other. Neural interfacing as an evolving trend in wireless communications by taking into account one of its important application i.e. cyborgs. A cyborg is a cybernetic organism (i.e. an organism that is a self-regulating integration of artificial and natural systems) part human part machine; it thrives on the inputs both from the living senses and from the machine interface, which acts as an enhancement module. Brain-machine interfaces (invasive and non-invasive) represent the most likely pathway. In this paper, we intend to tell, how exactly the cyborgdom is achieved and what are the future aspects and prospects? Are we witnessing a true revolution in human futuristics or is it going to be just a flight of fantasy? That the future will tell. But for now let us understand what Cyborgs are all about?

Keywords: Brain-Computer interface, Cyborgology, Exoskeleton, Neural interface

1. Introduction

Attachments and interfaces mediate our interaction with the environment and usually are positioned on the surface of the body. Physical things would be called tools or attachments, while information utilities would be called interfaces. A neural interface allows human brain converse directly with a computer, without any other equipment. That class of interface allows any illusions to be input to human nervous system. Neural interfacing fantasies have mainly grown out of science fiction. This human computer interface may now lead to a revolutionary organism called as “cyborg”, which was notion of as a science-fiction earlier.

A Cyborg: “Cyborg” is a science-fictional shorting of “cybernetic Organism”. The term was coined in 1960 when Manfred Clynes and Nathan S. Kline used it in an article about the advantages of self-regulating human-machine systems in outer space. Cyborg is defines as an organism that is self-regulating combination of artificial and natural systems[3], an organism that has enhanced abilities due to technology, though this perhaps oversimplifies the necessity of feedback for regulating the subsystem. “Cybernetic organism” has also been applied to networks, such as road systems, corporations and governments, which have been classed as such. A cyborg is essentially a man-machine system in which the control mechanisms of the human portion are modified externally by drugs or regulatory devices so that the being can live in an environment different from the normal one. Fictional cyborgs are portrayed as a synthesis of organic and synthetic parts, and frequently pose the question of difference between human and machine as one concerned with morality, free will, and empathy. Cyborgs in fiction often play up a human contempt for over-dependence on technology, particularly when used for war, and when used in ways that seem to threaten free will. Cyborgs are also often portrayed with physical or mental abilities far exceeding a human counterpart (military forms may have inbuilt weapons, among other things).

Fig. 1 A Cyborg



2. Origin

The concept of a man-machine mixture was popular in science fiction before World War II, and began with the field of cybernetics in the 1940s. “As early as 1843, Edgar Allan Poe described a man with extensive prostheses in the short story “The Man That

Was Used Up". In 1908, Jean de la Hire introduced Nyctalope (perhaps the first true superhero was also the first literary cyborg) in the novel *L'Homme Qui Peut Vivre Dans L'eau* (*The Man Who Can Live in the Water*). Edmond Hamilton presented space explorers with a mixture of organic and machine parts in his novel *The Comet Doom* in 1928. He later featured the talking, living brain of an old scientist, Simon Wright, floating around in a transparent case, in all the adventures of his famous hero, Captain Future. He uses the term explicitly in the 1962 short story, "After a Judgment Day," to describe the "mechanical analogs" called "Charlies," explaining that "cyborgs, they had been called from the first one in the 1960's...cybernetic organisms." In the short story "No Woman Born" in 1944, C. L. Moore wrote of Deirdre, a dancer, whose body was burned completely and whose brain was placed in a faceless but beautiful and supple mechanical body. In 1960, NASA scientists Manfred Clynes (a computer theorist) and Nathan Kline (a psychiatrist) delivered a paper in which they suggested that an enhanced human being could survive in extraterrestrial environments in space without space suits if modified with implants and drugs. They coined the term in refer to their conception of. For the exogenously extended organizational complex functioning as an integrated homeostatic system unconsciously, we propose the term 'Cyborg'. Manfred E. Clynes and Nathan S. Kline Their concept was the outcome of thinking about the need for an intimate relationship between human and machine as the new frontier of space exploration was beginning to take place. A designer of physiological instrumentation and electronic data-processing systems, Clynes was the chief research scientist in the Dynamic Simulation Laboratory at Rockland State Hospital in New York.

3. Social Cyborgs

"Cybernetic organism" is used to describe larger networks of communication and control. For example, cities, networks of roads, networks of software, corporations, markets, governments, and the collection of these things together. A corporation can be considered as an artificial intelligence that makes use of replaceable human components to function.

Communication between two cyborgs: It is assumed that wide area access between any number of people can be achieved by using internet. This internet would substantially form a cyberspace establishing a community of cyborgs in the near future. In this way cyborgs may revolutionize the present technology and can be used in even more areas of the world. But they should be provided with computer aided cameras. This technology would be implemented in almost all fields where human interaction is needed. For example: consider a uranium plant or space research centre which requires a wide variety of sensors to inform about special tasks. In these places human intervention is highly needed because even if we use autonomous sensors sometimes problems may crawl in. By using cyborg technology this problem would be simpler because if we interface humans with sensors then up to date information would be sent to the cyborg for instantaneous analysis of the status where ever he is.

Fig. 2 Computer Aided Camera



4. The Project cyborg 1.0

The question that erupted in the minds of Professor Kevin Warwick and his team at the department of Cybernetics, University of Reading intend to answer with 'Project Cyborg'.

What happens when a man is merged with a computer?

On Monday 24th August 1998, Professor Kevin Warwick underwent an operation, using local anesthetic only to surgically implant a silicon chip transponder in his forearm. This experiment allowed a computer to monitor Kevin Warwick as he moved through halls and offices of the Department of Cybernetics at the University of Reading, using a unique identifying signal emitted by the implanted chip. He could operate doors, lights, heaters and other computers without lifting a fin-

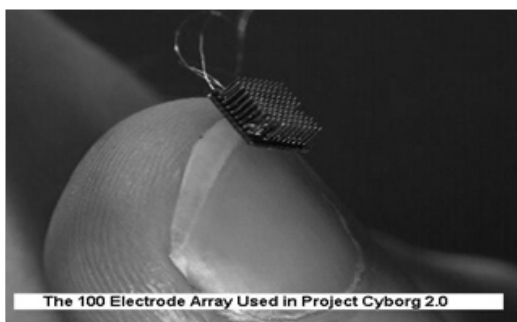
ger. The transponder consists of a glass capsule containing an electromagnetic coil which generated an electric current when a radio frequency signal is transmitted to the transponder and a number of silicon chips. It is approximately 23mm long and 3mm in diameter. This electric current is used to drive the silicon chip circuitry, which transmits a unique, 64-bit signal. On picking up the unique, identifying signal, a computer operates devices, such as doors, lights, heaters or even other computers. Which devices are operated and which are not depends on the requirements for the individual transmitting the signal. The implant was tested successfully for nine days before being removed.

5. Project cyborg

5.1 Step towards real cyborgs

On the 14th of March 2002, a one hundred electrode array was surgically implanted into the median nerve fibres of the left arm of Professor Kevin Warwick. The procedure, involved inserting a guiding tube into a *two inch incision* made above the wrist, inserting the microelectrode array into this tube and firing it into the *median nerve fibres* below the elbow joint. The purpose of this experimentation was to link the nervous system in the left arm, to a radio transmitter receiver; to send signals from nervous system to a computer and vice versa. The main part of the silicon chip consisted of a battery, radio transmitter/ receiver and processing unit. The interface to Professor Warwick's nervous system was a micro electrode array consisting of 100 individual electrodes implanted in the median nerve of the left arm. A *25-channel neural signal amplifier* amplifies the signals from each electrode by a factor of 5000 and filters signals with corner frequencies of 250Hz and 7.5 KHz. The amplified and filtered electrode signals are then delivered to the *neural signal processor* where they are digitized at 30,000 samples/second/electrode and scanned online for neural spike events. This means that only 25 of the total 100 channels can be viewed at any one time. Neural spike events are detected by comparing the instantaneous electrode signal to level thresholds set for each data channel. When a supra-threshold event occurs, the signal window surrounding the event is time stamped and stored for later, offline analysis. The neural stimulator allows for any of the 25 monitored channels to be electrically stimulated with a chosen repetition frequency at any one time. Once the chip was activated, scientists experimented with signals associated with motion and pain. When Warwick moved a body part, the signal was sent to the computer. The computer recorded and successfully replicated the movement by sending a signal back to Warwick. A number of experiments have been carried out using the signals detected by the array; most notably Professor Warwick was able to control an electric wheelchair and an intelligent artificial hand, using this neural interface.

Figure 3. *Electrode array*



6. Advantages and disadvantages

Whether it is a new rising technology, a new instrument or new equipment, everything has got its advantages and disadvantages. It depends on the user to make an appropriate use of equipped devices & the technologies. So, here is the lay down of advantages and disadvantages of CYBORG.

6.1 Advantages

The benefits of cyborg technology are vast and are expanding and are helping people live normal lives and in some cases give a better advantage physically the human cyborg represents a 'intermediary species' of sorts, before the human enters total post-biological obsolescence.

Fig. 3. *Electrode Array Used in Project*

Cyborg 2.0

1. Brain stem and cochlear implants enable
2. deaf people to hear again, and work progresses toward the first retinal and spinal cord implants.

3. Artificial hands carry out simple actions with a myoelectric sensor entrenched into the user's residual limb or stump. Super-strong prosthetic legs use shock-absorbing springs at the toe and heel to bounce from one step to the next.
4. If evolution is theorized from a theoretical perspective as an attempt to increase the information processing power latent in matter, it is clear that artificial life will eventually win out against organic life since it is more durable and more efficient.
5. We can 'graduate' from being victims of natural selection to masters of self-selection. It seems hard to argue against increasing human longevity, intelligence, or strength, since human beings seem to live too short a span, to make too many mistakes in reasoning, and to lack the physical survival necessary to make great accomplishments.

6.2 Disadvantages

With such advantages in technology come worries of the uses of the advancement. The critics of bioelectronics and bio computing foresee numerous potential negative social consequences from the technology.

1. One is that the human race will divide along the lines of biological haves and have-nots.
2. People with enough money will be able to fight their personal attributes as they see fit as well as to utilize cloning, organ replacement, etc. to stave off death for as long as they wish, while the majority of humanity will continue to suffer from hunger, bad genes, and infirmity.
3. This would be tremendous violation of human privacy, but the creators of human biotech might see it as necessary to keep their subjects under control. Once implanted with bio-implant electronic devices, 'cyborg' might become highly dependent on the creators of these devices for their repair, recharge, and maintenance.
4. It could be possible to modify the person technologically so that body would stop producing some essential substance for survival, thus placing them under the absolute control of the designer of the technology.
5. Humanity which is not found in animals or machines and which makes us uniquely human, worry that the essence of our humanity will be lost to this technology.
6. Technophobiacs argue that in the immoral hands cyborg technology can be used as a weapon and a dominant one at that. From mind control, with the use of computer chips implanted in human brains to super-human war machines.

7. Cyborg Technology: Impact On Human Kind

The ways in which this new age of cyborg technology will impact and has impacted human kind are very exciting. In the foreseeable future humans will be far more capable than they are today. British cybernetics professor Kevin Warwick, who has already had a silicon chip implanted in his arm, says those who choose not to cyborgize may face the scorn of the super humans who do. Those who have become cyborgs will be one step ahead of humans. And just as humans have always valued themselves above other forms of life, it's likely that cyborgs will look down on humans who have yet to "evolve". In order to avoid potential dangers in the future we as humans need to realize making a step towards playing "god" can have consequences beyond our comprehension. In order to prevent potentially dangerous situations due to the technology, certain boundaries should exist and a deep understanding of us needs to be reached before we take the leap of faith and regret it. If caution is not used with the advancing technology some say a soulless bored organism will be created and the basic needs and instincts that have gotten humans to where they are today may not exist. If taken too far the technology may complicate an already incredibly complex world. The direction in which the technology should be taken to aid humankind may be the greatest question of all. Leading researchers have predicted the future of cybernetics to eventually reach the point where our brains will be "wired" to the internet and all humans integrated to one data base. However the ability to choose our path of evolution may be the beginning of the end of the human race. Nature has a strange way of balancing the unbalanced. If we currently regard ourselves as the supreme form of life, then the future super/post human will regard us as primitive. When this stage of evolution is reached we will theoretically evolve into what we modern conceive as "god".

8. Applications

8.1 In medical field

In medicine, there are two important and different types of cyborgs: the restorative and the enhanced. Restorative technologies "restore lost function, organs, and limbs". The key aspect of restorative cyborgization is the repair of broken or missing processes to relapse to a healthy or average level of function. There is no improvement to the original faculties and processes that were lost. A brain-computer interface, or BCI, provides a direct path of communication from the brain to an external device, effectively creating a cyborg. This technology could enable people who are missing a limb or are in a wheelchair the power to control the devices that aide them through neural signals sent from the brain implants directly to computers or the devices. It is possible that this technology

will also eventually be used with healthy people. Deep brain stimulation is a neurological surgical procedure used for therapeutic purposes. This process has aided in treating patients diagnosed with Parkinson's disease, Alzheimer's disease. Retinal implants are another form of cyborgization in medicine.

8.2 In Art

Artists have explored the term cyborg from a perspective involving imagination. The idea of cyborgation to relate to most people with science fiction, they tend to think cyborgs exist only with imagination of writers and artists. Cyborgs get renowned through science fiction films and stories of writers.

8.3 In military

The military has already considered the possibility of the super-soldier, augmented by technology so that he has faster reflexes, deadlier accuracy, greater resistance to fatigue, integrated weaponry, and most importantly, lesser inclinations toward fear or doubt in combat. In Defensive application, the cybernetics is held for the progress of "cyborg soldier". The cyborg soldier often refers to a soldier whose weapons as well as the survival systems are integrated into the self, creating a human-machine interface. Military Organisations has recently decided on the utilisation of cyborg animal. DARPA has announced its interest in developing "cyborg insects" to transmit data from sensors implanted into the insect during the pupa stage. The insect's activity would be controlled from a Micro-Electro-Mechanical System (MEMS) and could conceivably survey an environment or detect explosives and gas. Powered Exoskeleton is a diverse proposed product from cyborgology for military use, which combine a human control system with robotic muscle.

9. Next in future

After all the nerve wrecking experience with, this supra-fascinating world of cybernetics, the most logical query that strikes the mind is what is the future? With all the developments in the field of Robotics and Human Technology integration, some exciting facets to look out for are-

Thought signals Communication: - In present era of communication, *Speech* an old fashioned, out dated means of communication, is very slow, serial and error prone. The potential to communicate by means of thought signals alone is a very exciting one. We will probably have to learn how to communicate well in this way though, in particular how to send ideas to one another.

Remote Medical facilities: - The technology enabling doctors to perform surgeries while being remotely situated from the actual place where the patient lies is old enough. This is just an extension of it. Initially there used to be a robotic hand having sensors that used to sense the physiological symptoms of the patient and then transmit them to the remote doctor, the doctor used to have his hands in special gloves, which were equipped with devices that created the same sensations for the doctor to feel. The doctor may then manipulate his hands in order to proceed for the surgery and the robotic arm would copy the movements. All the time visual data could be uplinked through networks.

Medicine: - Possible electronic medicine - electronic signals to remove headache, as a tranquillizer, to bring about pleasure etc. Possible pain equalizer - direct immediate painkiller. As all the feelings associated with pain and sickness, arise from the brain and are electric in nature, they can be superimposed with artificial signals opposite in phase, so that sum is zero. Thus pain and aches could be neutralized without drugs.

Super beings: - Imagine having infinite memory, and being able to recall it at your wish, is possible with the implants; all the experiences of an individual, even those which he has not experienced himself may be stored in computer memories. Whenever he requires them they can be sorted and replayed to him, through the implant. And then there will be the added processing ability, you could perform a zillion operations on your own. The results would come from your brain. We can have audio files playing directly into our brain, eliminating the need of Players. Movies can be screened directly into the optical nerves. Move aside SMS, we can have TMS, standing for *Thought Message Service*. Want to drive your car, just think of the way it has to navigate and zip through. Need to order items for that Party, just wish and Cybernetics will make them its command.

10. Conclusion

As many scientists have eloquently argued, once a technology is out there, you cannot make it go away. There never was a technology that the human race ever abandoned wholesale, even the hydrogen bomb or other weapons of mass destruction with the

power to wipe out all life on Earth. Humans have limited capabilities. Human sense the world in a restricted way, vision being the best of the senses. Cyborgology is the future technology for the purpose to be get real. Even it has some major ¹defects and wrong sides as like any technologies evolving nowadays. Safeguards will have to be insisted on to prevent the possible negative impacts discussed above, and many of these things will have to be built in at the instrumental level, since they probably cannot be achieved only through policy and regulation. If the future of intelligent robots, then to protect mankind, we will must need CYBORGS. Because by making human CYBORGS, we may have the following extra ordinary capabilities. We will be able to communicate between each other by thoughts signals alone, so no more need for telephones, old fashioned signals, we all are able to think to each other via implants. Instead of communicating by speech as we do presently, we will be able to think to each other, simply by implants connected to our nervous system linking our brains electronically together, possibly even over the internet. We won't need the languages that we presently have; we'll need a new language of ideas and the concepts in order to communicate thoughts from brain to brain

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