Who will rule the world in the future? Can new technologies dramatically change humanity as we know it?

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Who will rule the world in the future?

Can new technologies dramatically change humanity as we know it?

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Abstract

New technologies are dramatically changing human civilization in a way few could have imagined even at the end of the 20th century. And yet, many things will change even more. Very soon, computer intelligence will surpass the abilities of the human brain, genetic research and regenerative medicine will create practically immortal genetically enhanced humans with super-intelligence and superpowers, and natural people will become a minority in the world of human cyborgs. In such a new world, the supremacy of humans will be disputed. This paper presents the issues arising from the mind controlled devices, pointing out those viewpoints which might completely destroy, and those which can preserve the equilibrium of the world we live in.

Keywords: bioengineering, brain-computer interaction, transhumanism

Introduction

In 1950, when vacuum tubes started being implemented in the first commercial computers, Norbert Wiener highlighted that the new industrial revolution might destroy humanity (Norbert, 1950). Exactly 50 years later, Bill Joy was deeply concerned that the powerful new technologies: genetic engineering, nanotechnology and robotics could cause knowledge-enabled mass destruction (Bill, 2000). Soon afterwards, Andy Clark asserted that in the very near future, human beings will become human-technology symbionts (Clark, 2001). Clark added that humans have dual innovations: the cortical plasticity and unusually long period dedicated to development and learning, giving them the unique predispositions to be natural-born cyborgs (Clark, 2003, pp. 23, 42). He was extremely fascinated by the, at that time, dubbed ubiquitous computing, believing that new technologies will soon offer the human-machine integration and transformation without implants or surgery. All these assumptions strengthen Kurzweil's "Law of

accelerating returns", which states that the evolution steadily reaches the fifth epoch, the moment when human technology starts merging human intelligence (Kurzweil, 2005).
Since then, technologies have considerably evolved, enabling more comprehensive verification of the certainty of all the assertions presented so far. None of the frightening expectations has become true so far. On a contrary, the quality of life has significantly improved, life expectancy increased, communication and language understanding have never been so easy, medical diagnosis so precise, weather forecast so accurate, sport records so fascinating, and the access to ideas, skills and knowledge and their exchange so widely spread. However, a lot of scary, and at the same time very thrilling scenarios of the future continue, revealing that several sciences, such as artificial intelligence, bioengineering, metaphysics, military science, neurobiology, quantum mechanics, and even aeronautics and astronomy might considerably transform our present-day world. Some of the changes will be beyond human control.

At the moment, one of the most dangerous technological disciplines are brain-computer interfaces (BCI), particularly when they are researched in a conjunction with nanotechnology, neuroscience and machine learning. Even if used wisely and with the greatest responsibility, connecting the mind with machines might break the existing balance in the world. This paper will try to prove this claim. The development, successes and the most recent implementations of BCI will be examined in the second section. Ethical issues will be the major topic of the third section. Their improper implementation might generate a zero-sum game status of the whole BCI research, making it completely counterproductive. The zero-sum game property will be illustrated in the fourth section. Paper will be concluded with few answers, remarks and questions about the never-ending dilemma: who will rule the world in the future?

Overview of human-computer interfaces

The human nervous system is a network of almost one hundred billion neurons. It transmits information in a form of electrical signals. Electric currents produce magnetic fields. The electrical activity of the brain was first detected by Richard Caton in 1875 (Richard, 1875). The discovery was successfully implemented by Hans Berger in the electroencephalogram (EEG), a machine that monitors and records human electrophysiological activity (Hans, 1929). The nuclear magnetic response was first imaged by Paul Lauterbur, who developed the magnetic resonance imaging (MRI) (Lauterbur, 1973). Applying, practically the electro-magnetic properties of the brain, brain-computer (BCI) or brain-machine interfaces (BMI) enable communication with the brain's neuromuscular output channels of the peripheral nerves and muscles by translating the electrical signals produced by the brain activity into outputs that can be observed by various devices (Wolpaw, Birbaumer, McFarland, Pfurtscheller, & Vaughan, 2002). Communication doesn't depend on the neuromuscular output channels, because peripheral nerves and muscles don't participate in the interaction.
Apart from diagnostic purposes, BCI has intensively been applied to control the devices that increase, maintain, and improve the functional capabilities of individuals with disabilities (Rupp et al., 2014

). The symbioses between BCI and assistive technologies is successfully implemented in neuro prostheses, which encompass:

- Cochlear, brain stem, and auditory membrane implants intended for hearing impaired persons;
- Retinal implants that restore functional vision of visually impaired;
- Spinal cord stimulators that exert electrical signals to control the pain, and stimulate motor cortex activity of people with chronic pain or motor disorders;
- Motor neuroprostheses that restore the mobility of persons with motor disabilities;
- Cybernetic sensory prostheses, which can mimic the contractions of muscles in artificial limbs;
- Cognitive prostheses that restore cognitive functions of persons suffering from various health disorders, such as Alzheimer's and Parkinson’s disease, traumatic brain injury, and paralyses.

All these inventions have increased life expectancy and vastly improved the quality of life of millions. However, some of them, particularly the cybernetic systems lead towards “cyborgisation” of humans, raising serious ethical concerns (Warwick, 2003). Warwick has personally experienced the evolution of human beings into cyborgs (Warwick, 2000). In 1998, he implanted a silicon chip in his arm. Using radio waves, the implant communicated with several devices from the Department of Cybernetics in Reading. Later on, he implanted an array of 100 electrodes in the median nerve fibres of his left arm, and using the decoded signals from the implanted device he managed to control an electric wheelchair (Warwick et al., 2003). Based on his personal experience, he believes that future cyborgs will be intellectually far more powerful than humans, with a different view of life, different values, moral and ethics, and that they will never voluntarily give up their powers. New research programs confirm his doubts. The most terrifying BCI initiatives will be presented in the following paragraphs.

In 2013, DARPA joined the BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative (DARPA, 2013). Their projects target: self-healing of body and mind; wireless communication of neural-interface microsystems with prosthetic modules; visualization of the entire brain; extraction of information from the nervous system; restoration of active memory; and accelerated learning by stimulating synaptic plasticity. Is the ultimate outcome of these projects a super-intelligent self-healing human cyborg?
In 2014, Google acquired DeepMind, a research start up that created a neural network capable of learning how to play the video games. Their program AlphaGo combined deep neural network and reinforcement-learning algorithm and triumphed over a professional human competitor in the board game Go (Deep Mind, 2017). The neural network unveiled how to mimic the short-term memory of human brain. A very recent success of Google Brain is the inhuman encryption algorithm established by two neural networks that communicate among themselves in a way the third neural network can’t understand them (Abadi & Andersen, 2016). Fascinating, isn’t it?

Another very intriguing project is Elon Musk’s Neural Lace, which actually started in the DARPA’s research laboratories. The idea of the project is to inject a computer interface into the jugular, and then transmit it towards the human brain (Musk, 2016). The neural lace will wirelessly transmit signals to external devices, enabling direct connection to Internet by thinking about it only. As Elon Musk concludes, probably “We are already cyborgs”.

Apart from the activities within the BRAIN initiative, DARPA and the University of California launched the controversial project “Silent Talk”, intending to enable synthetic telepathy, or communication through the power of thought (Drummond, 2009). Although very few information can be found about it, many researchers from USA and South Korea were encouraged to work on non-invasive brain-to-brain interfaces (BBI). The research funded by the Army Research Office managed to establish a direct brain-to-brain interface in humans (Rao et al., 2014). Two persons were mutually cooperating to achieve a desired goal in a computer game. The sender was transmitting recorded EEG signals over the Internet to the motor cortex region of the receiver, causing the desired response, i.e. pressing the touchpad.

It is a question of time when will the BCI and BBI achievements be effectively connected with the projects directed towards the creation of artificial life and artificial brains. The first steps have already been done. In 2010, the first cell with a synthetic genome was produced (France, 2014). After building the first artificial cell membrane, scientists managed to create the first synthetic eukaryote. In the history of humanity, similar macromolecules were evolving millions of years to reach the current stage of development. With the present-day models of large-scale single-cell neural simulations and rapid technological development, the moment when artificial brains become comparable to a human brain is undoubtedly very close (Eliasmith, 2013). It is expected that these brains will successfully solve perception and cognitive tasks. They will also effectively simulate brain’s neuroplasticity, enabling compensation of injured or diseased neurons, and adjustment of activities in response to new situations or changes in their environment.

Ethical issues of brain technologies

For decades, brain technologies that were successfully used for diagnostic purposes, and many implanted neuro prostheses made the life of millions better, simpler and more dignified. Cochlear and retinal implants are widely used. Deep brain stimulation (DBS) is successfully implemented for patients suffering from chronic pain, major depression, essential tremor, obsessive-compulsive disorder, Alzheimer’s(Sauer, 2016), and Parkinson’s disease (Palfreman, 2016). Neuro-stimulators controlled by a pacemaker-like devices are implanted in the brain and send electrical impulses that control and block the abnormal nerve signals and chemical reaction of patients. Unfortunately, both blogs presented in the footnotes 22 and 23 report that DBS could cause serious neuropsychiatric side-effects. Once again this opens the dilemma whether brain technologies are ethical or not? This section will try to tackle the most obvious ethical issues, starting with the responsibility, safety and reliability, continuing with the security and privacy, and ending with the machine liability, metaphysical free will, consciousness, and emotions.

The responsibility problem covers: the prospective eligibility of the candidates for a BCI treatment, the right to undergo the treatment, the responsibility of the treatment, but also the mental competence of the patient's personality resulting in damage caused by undesirable or even deviant behaviour. Particularly important is the responsibility of unpredicted reactions caused by people with brain implants who perform an activity that might endanger others (Zdravkova, 2016). For example, if a patient with a retinal implant initiates a car accident due to a technological failure, it is doubtful who takes the responsibility for the accident, the manufacturer or the person who caused the accident. It might look very similar to the situation when an accident is a result of accidentally broken spectacles during driving. If the patient is warned that such a problem might occur, and the problem has never happened before, then patient's accountability and manufacturer responsibility should be examined more thoroughly. But, if such failures happened frequently, the responsibility is definitely purely technical. In both cases, the undesired consequences can occur.

As reported in the first paragraph of this section, DBS implants are not totally safe, and they can cause temporary negative effects. Hopefully, the undesirable consequences are reversible, but in the critical moment they might exist. Apart from this problem, there were many examples when brain technology triggered an instant paralyses, stroke, and even death of the patient. In many occasions, the unsafe issues of brain stimulators happened. They included unwanted risks, poor anatomic accuracy and uncertainties, or risks of infection and haemorrhage. Similarly to the example explained it the previous paragraph, it is very uncertain who should be blamed if such a circumstance occurs, especially when the patient is performing a safety critical task. One solution is to prevent patients undergoing a BCI treatment of any kind, to execute any safety critical tasks. But, is such a discrimination worthwhile, how far should it go, and does it affect the human dignity?

The durability, reliability, and robustness of any technology are potential weak points. Few years ago, Walpaw (2002) revealed that current brain-computer interfaces are challenged by several problems connected with the signal-acquisition hardware, and enlarged with the lack of convincing clinical validation, brain-computer interface dissemination and support. Consequently, the probability that mind-controlled devices perform their intended function under encountered operating conditions can decrease. And, who can guarantee that the operating conditions are always ideal, particularly because they are directly correlated with the physical and psychological state of the patient.

Communication between the human brain and the computer external devices is bidirectional: brainwaves are monitored with invasive or non-invasive devices, and the devices stimulate, assist or repair cognitive and sensory-motor functions. The monitoring process is performed using the Internet, remote or wireless connection. As a result, brain implants are extremely insecure; they can be easily hacked and maliciously interfered. The modern threat of bio-electronic implants, particularly those that enable synthetic telepathy, is popularly called brain-jacking (Pycroft et al., 2016). Brain-jacking refers to the situation when attackers establish an unauthorized access to implants, in order to manipulate with the patients. If the prohibition to perform safety critical tasks doesn't decrease human dignity, brain-jacking definitely does. Even without the brain-jacking, permanent monitoring of brain activity, collection, and processing of monitored data, including very private or sensitive ones is the unquestionable privacy threat. For now, the human mind is still impenetrable. With the synthetic telepathy, the possibility to read other's thoughts will become very realistic. Current audio, video, telephone and Internet surveillance will be extended to brainwaves surveillance. No inner feelings, beliefs and opinions, no secrets, nothing will exist. The inner life will totally degrade. At that moment, Orwell's "Big brother" scenario will be overwhelmed.

The next four ethical problems are related to the future evolution of the brain computer interfaces. Although many machines, particularly industrial robots, computer game bots, and computer systems with sophisticated artificial intelligence algorithms that perform their tasks much better than humans, no one expects machines to be accountable or liable. In the forthcoming mind controlled systems, liability should be seriously reconsidered. Brain technologies should not trigger any risks at all. They should be able to make their own decisions based on complex knowledge databases and rules embedded in their software. Such systems should have the ability to draw unbiased conclusions, without any pressure, avoiding conflicts of interest. Could they still make a mistake, mainly due to a forgotten branch in the decision tree? While they depend on the code designed by human researchers and written by human developers, the reliability problems will depend on the professional liability of their creators. Super-intelligent self-organizing systems should be absolutely faultless. Otherwise, the absence of machine liability will seriously endanger their users.

Moral responsibility is closely connected with the free will (O'Connor, 2016). It can be treated as the ability to select one course of action among several offered, or the ability to do otherwise. In both cases, the right to self-determination is crucial, where one's beliefs, desires, and external factors influence the free choice. Whenever persons act with free will, they actually satisfy the metaphysical requirement on being responsible for their actions. Should the brain implants be granted the liberty to free will, or they must strictly obey only the deterministic rules embedded in their own decision trees? One conditional answer to this questions might be: if the brain implants have a self-consciousness as human beings, they should also have the metaphysical free will. But, is artificial consciousness possible?

Artificial (or, machine) consciousness has been intensively researched and examined during the last two decades. Reggia has exhaustively surveyed and illustrated these models of consciousness by examining representative example (Reggia, 2013). He concluded that computational models have successfully managed to correlate with the conscious information processing, albeit there is not a clear evidence that artificial consciousness will eventually be possible. However, artificially inducted loss of consciousness caused by an electrical stimulation of a specific and limited brain region has been experimentally proven (Koubeissi, Bartolomei, Beltagy, & Picard, 2014). It is very possible that the opposite impact, the gaining of self-consciousness will soon be inducted. Both, cognitive psychology and neuroscience develop much faster than ever, and the crucial argument towards an expected machine consciousness is their joint growth. Therefore, it should be expected that new brain implants will have an embedded consciousness. Their level will inevitably depend on the consciousness of their creators.

A very interesting area of computing has recently been progressed: affective computing (AC). AC tends to understand emotions and sentiments, in order to emulate human intelligence and to leverage human-computer interaction(Cambria, 2016). Many experiments with humanoid robots managed to simulate human emotions, by generating gestures that mimic human smiling, corrugating or snarling. Some of them, like Han from Hanson Robotics are capable of understanding human facial expressions and react correspondingly (Hanson Robotics, 2017). Han smiles, winks, frowns, and even pretends to be drunk. So, can robots have real emotions, including sentiment or empathy? Yes, if they are programmed to avoid carrying out unintentional harm, as Isaac Asimov's good old postulate.

If machine liability, metaphysical free will, consciousness, and sentiment are well embedded in the future brain implants, they will respect human dignity. Otherwise, enhanced humans will humiliate or diminish the self-worth of intellectually inferior beings, they will treat them as instruments to fulfil their own goals, degrade their values, exploit them severely, and whenever they want; they will even excommunicate them.

Are brain technologies a zero-sum game?

According to Peldschus, "zero-sum describes the situation in which a participant's gain or loss is exactly balanced by the losses or gains of the other participant(s)" (Peldschus, Zavadskas, Turskis, & Tamosaitiene, 2010). It seems that brain technologies can be exactly matched with such a game. Let the participants of the game be: natural humans, enhanced humans, implant controllers, synthetic telepathists, and an artificial brain (Fig. 1).

Figure 1. Zero-sum status of brain technologies

Natural humans are those human beings that have no silicon chips, no pacemakers, nor brain implants incorporated in them. Some scientists call them organic people (Louis Del Monte), or electronic virgins (Andy Clark). The human brain loses thousands of neurons daily and without the possibility to regenerate them. Hopefully, they are replaced by new and fresh neurons (Nottebohm, 2002). However, while aging, most of the human organism functions deteriorate, including the mental abilities. One of the possible ways to increase the life expectancy, physical and mental capabilities of natural humans is to get an implant. With these implants, they move to the category of enhanced humans.

Enhanced humans should not necessarily have any of the problems mentioned in the previous paragraph. They can start using various neuro prostheses, to improve their

already excellent hearing, vision, and physical abilities. By enriching the function of their organs, replacing the injured parts, and particularly with the possibility to quickly self-heal, such humans will defeat even the natural super-humans. Furthermore, mind-expanding devices will increase the brain cognitive functions, and intellectual capabilities of healthy people with implanted brain interfaces will become too advanced to standard natural human mind.
When neuro implants of any kind become more reliable, and more sophisticated, and similarly to embellishment gadgets, many natural humans will start using them, which will not be only embedded tools. Neuro prostheses intended for healthy people will be tailored to make them exceptionally strong, healthy, and clever.

According to current technology, fetching and storing of neural implant data is performed using distant servers, which are remotely or wirelessly interfaced and controlled. All the engineers which have an access to stored data or can access the transmitting channels, might interfere the smooth functioning of the devices. The obstruction can be benevolent, such as the snooping, done to satisfy the engineer's curiosity, but also malevolent, particularly if it is performed by intruders who want to take advantage of the technology for immoral goals. They could cause data modification, denial of services, or malware installation. In all these cases, the function of neuro prostheses could completely deteriorate, making the enhanced humans inferior to the state before implanting them.

Even the most ethical implant controllers, who are entirely dedicated to the creation of a perfect environment and impeccable conditions for neural implants are not immune to brain-to-brain disturbance. The synthetic telepathists could convince them to compromise the behaviour of neuro prostheses, to act irresponsibly, and to destroy all the system. The mind controllers will have a very easy task with implant intruders. Using the "silent talk", or silent communication, they will only motivate the intruders to make an ever greater harm to their holders. In both cases, the advantage of enhancing humans will become counterproductive.

By now, the artificial brain is still science fiction. But, many fictions can became a reality, on many occasions prior to the expected date. The artificial brain will have its own free will and it will be self-conscious. Particularly the artificial brain prototypes will have a limited responsibility, and no emotions. Furthermore, they will start experiencing their own metaphysical free will, which will strongly influence their behaviour, particularly towards the competing beings, the synthetic telepathists. They will have their own inhuman encryption algorithms, disabling any other to monitor and obstruct their functioning. Their main mission will be to rule the world.

Will artificial life and artificial brain manage to fulfil their mission? Probably not, because their algorithms will be created and implemented by natural humans. Humans will create the artificial mind, intentionally leaving security defects, buffer overflow vulnerabilities, bugs, and a possibility of over-privileged users, which will afterwards be used to influence their behaviour. Such weaknesses in the artificial mind might be used (and misused) by their creators, by people who engaged the scientists to create the artificial mind for their own egoistic purposes, or might even accumulate and cause redirecting of the intended mind-controlled function in a completely wrong direction.

It seems that the development of brain technologies has created a typical vicious circle. It can't be, and it shouldn't be stopped. Instead, if the very positive ethical choices are embedded in the new devices, then the vicious circle will become a real virtuous circle, beneficial for the humanity, environment and the entire life.

Conclusion

Human lives are intertwined with technologies. Pervasive computing, which was a science fiction at the end of the 20th century is now a reality. It turns everyday devices into smart devices, highlighting the concept of Internet of things. The effects of new network technologies and tools have a tremendous effect on society. Therefore, Andy Clark's conclusion, that people are natural-born cyborgs is absolutely true. Modern people persistently interact with technology and they assign more and more obligations to their small technical gadgets, tools and smart devices.

The next step is the transformation, of the cyborgs we are today, into bionic people. There are already several researchers (for example, Kevin Warwick, who was mentioned in this paper) and people with different disabilities who have experienced the integration of machines into their own organisms. The success of brain-machine interfaces and mind-controlled devices is indisputable. They helped many people experience a better, easier or more comfortable life than previously.

The first fascination by merging humans and technologies will continue. Unfortunately, it should be expected that there will be potential threats of interacting with the brain, particularly because they have not been recognised by the legislation systems yet. Therefore, people who misuse the technology couldn't be prevented from doing so. One of the greatest drawbacks of brain-computer interfaces is that they are able to read the brain's electric activities. However, an even greater risk is the interference with the brain's activities, which might appear with the telepathic systems that are under development.

There are several devastating apocalyptic scenarios related to brain technologies: creation of super-intelligent, self-healing, and practically immortal cyborgs or bionic people who will try to entail their own free will; benefitting from enhanced people, who will be governed by powerful individuals, whose main intention is to rule the world; designing artificial people who will conquer the world and eliminate their opponents, the natural people.

The awareness of consequences of unethical use of technology in the democratic societies has never been so high. Scientists have high moral obligations, they are professionally responsible and know how to avoid the deficiencies their research may produce. Therefore, the author of this paper believes that the researchers will soon start developing empathetic, emotionally intelligent, and self-conscious machines whose sole purpose will be to help humans, improve human and animal lives and make the world a much better place than it is now. In this new world, human weaknesses and vices will be supressed, criminal activities minimized and the influence of new technologies will be used for the promotion of more secure and relaxing life.

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