

## Cognitive Implants

We are already past the middle of the second decade of the 21<sup>st</sup> century. Over one hundred years ago, World War I was about to start. Einstein's "annus mirabilis" papers were just nine years in the past. The first computers were about 25 years ahead, counting Conrad Zuse's 1938–1939 et. seq. work on the Z1 and Z2, especially, as seminal. 53 years ago—1964—marked the introduction of the IBM 360 computer. Roughly 40+ years ago, the first paper on the Internet's core Transmission Control Protocol was published, the first hand-held mobile was being prototyped, and the Ethernet was invented. About 30+ years ago the Internet was formally launched into operation and Apple announced the Macintosh. Way back in 1989, the World Wide Web was invented, the Mosaic Browser appears, and the so-called dot-com boom is poised to take off.

Every time I see calendar dates like 2017, I feel as if I have been transported by time machine into the future. It could not possibly be 2017 already! Isaac Asimov made some remarkably astute projections about 2014 in 1964,<sup>a</sup> so what might he say today?

What we can reasonably see today is the emergence of a crude form of cognitive accessory that augments our remarkable, but in some ways limited, ability to think, analyze, evaluate, and remember. Just as readily available calculators seem to have eroded our ability to perform manual calculations, search engines have tended to become substitutes for basic human memory. The search engines of the Internet have become the moral equivalent of cognitive implants. When I cannot think of someone's name or a fact (an increasingly common phenomenon), I find myself searching my email or just looking things up on the World Wide Web.

In effect, the Web is behaving like a big accessory that I use as if it were just a brain implant. Maybe by 2064 I will be able to access information just by thinking about it. Current mobiles, laptops, tablets, and Google Glass have audio interfaces that allow a user to voice requests for information and to cause transactions to take place. Whether we ever actually have the ability to connect our brains in some direct way to the Internet, it is clear we are fast approaching the ability to outfit computers (think "robots") with the ability to know about, perceive, and interact with the physical world.

It has been speculated that machine intelligence and adaptive programming will be the avenue through which computers will become increasingly cognizant of the world around them—increasingly behaving like self-aware systems. In addition to so-called "cyber-physical systems" that provide sensory input to computers and are expected to interact with the real world, an increasing degree of augmentation of our human sensory and cognitive capacity seems predictable. While we joke about memory upgrades or implants, search engines and the content of the Internet and World Wide Web act like exabyte memories that are reached through direct interaction with the computers that house them. Ray Kurzweil's virtuous, exponential computing functionality and capacity growth predictions, even if overly bold in the short term, strike me as potential underestimates of what may be possible in 50 to 100 years.

When we are on the cusp of generating an Internet of Things, humanoid and functional robots, smart cities, smart dwellings, and smart vehicles, to say nothing of instrumented and augmented bodies, it does not seem excessive to suggest the world of 2064 will be as far beyond imagining as 2014 was in 1964, except that Asimov had a remarkably clairvoyant view of what 50 years of engineering and discovery could achieve. A huge challenge will be to understand and characterize the level of complexity of such a world in which many billions of devices are interacting with one another often in unplanned ways.

For those of us who were around in 1964, we may recall our naïve aspirations for the decades ahead and realize how ambitious our expectations were. On the other hand, what is commonplace in 2017 would have been economically unthinkable 50 years ago. So perhaps exabyte, cognitive implants are a trifle ambitious in the short term, but a lot can happen in 50 years time. Just as we have adapted to the past 50 years, I expect we will rapidly embrace some of the functionality coming in the next five decades. It is already difficult to remember how we lived our lives without mobiles and the Internet. Now, where did I put that time machine?

Let's not wait 50 years to see what's already happening... Now! A lot is related to helping people with handicaps, but sooner than one may think something as big, or bigger than the development of language by humans just may be imminent. Elon Musk says that it's probably going to be at least "eight to 10 years" before the technology his new company, Neuralink, produces can be used by someone without a disability, e.g., the general public. Neuralink is aiming to create therapeutic applications of its tech first, which will likely help as it seeks the necessary regulatory approvals for human trials. Ultimately, Musk seems to want to achieve a communications leap equivalent in impact to when humans came up with language – this proved an incredibly efficient way to convey thoughts socially at the time, but what Neuralink aims to do is increase that efficiency by multiple factors of magnitude. And, as you will see below, Musk is but one player.

BRAIN COMPUTER INTERFACE

## Mark Zuckerberg is set to develop mind-reading brain implants



By BrainPedia.org

Posted on February 10, 2017



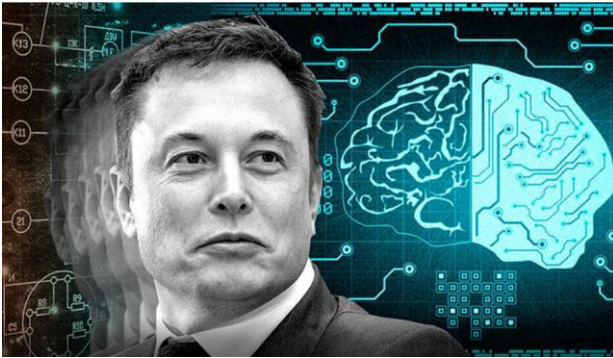
BRAIN COMPUTER INTERFACE

## Elon Musk wants to merge the human brain with AI, launches Neuralink

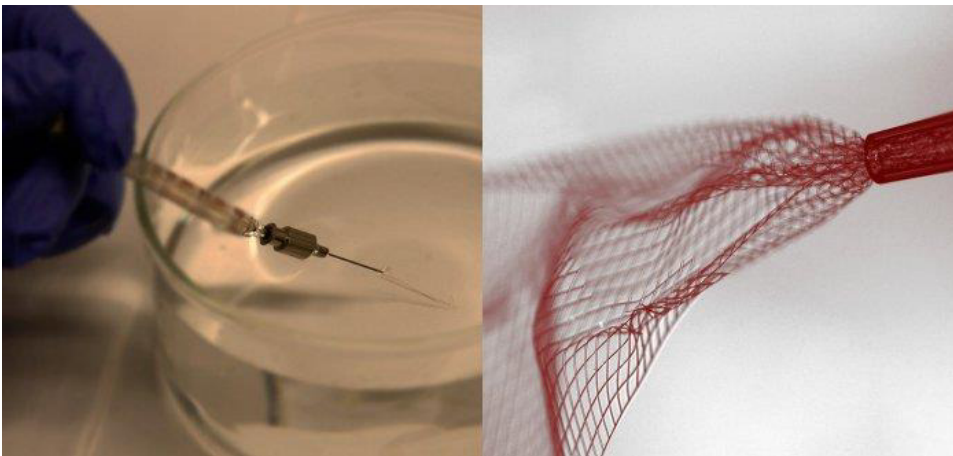


By BrainPedia.org  
Posted on March 30, 2017

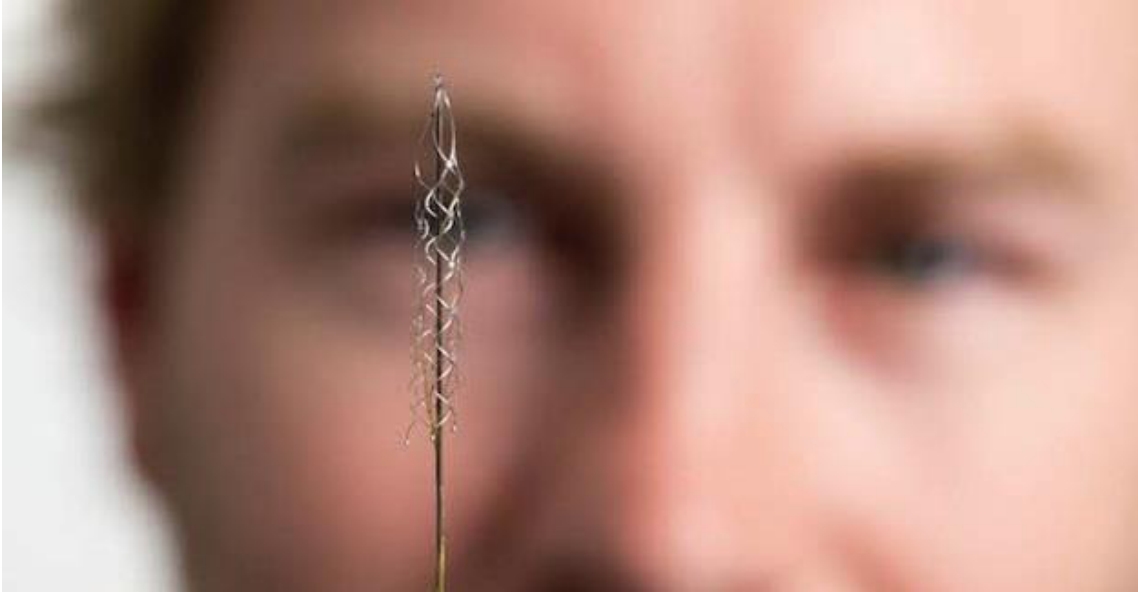
## Neuralink, Neural Lace and the Human Singularity: Elon Musk Launches New Company



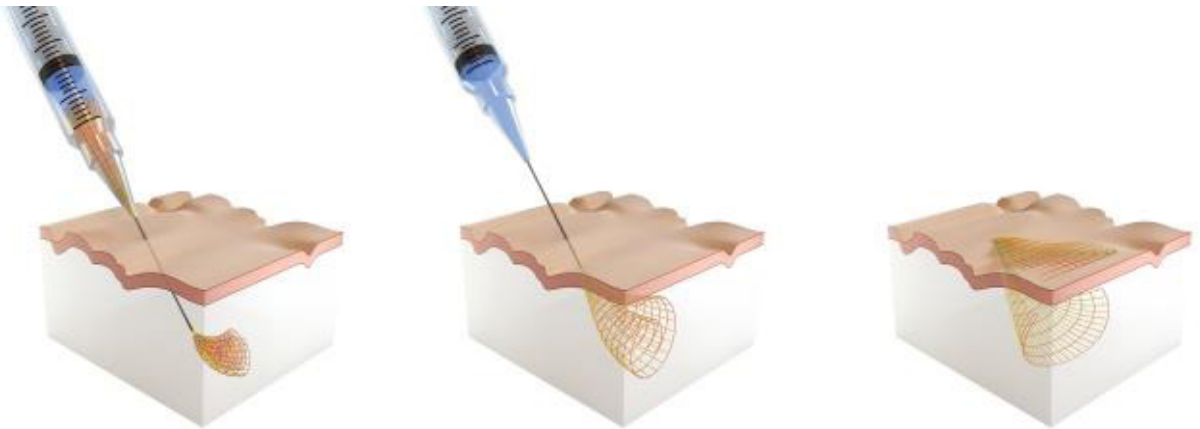
And you won't have to have a hole drilled in your skull. For example, a Harvard Medical lab has developed a neural lace that is injectable without surgery.



Credit: Lieber Research Group, Harvard University



This tiny device, known as a stentrode, can read signals from the brain's motor cortex. It will be implanted into humans in 2017 to use these signals to control an exoskeleton. (Photo: University of Melbourne). "We have been able to create the world's only minimally invasive device that is implanted into a blood vessel in the brain via a simple day procedure, avoiding the need for high risk open brain surgery," explains Dr. Thomas Oxley, principal author and Neurologist at The Royal Melbourne Hospital and Research Fellow at The Florey Institute of Neurosciences and the University of Melbourne.

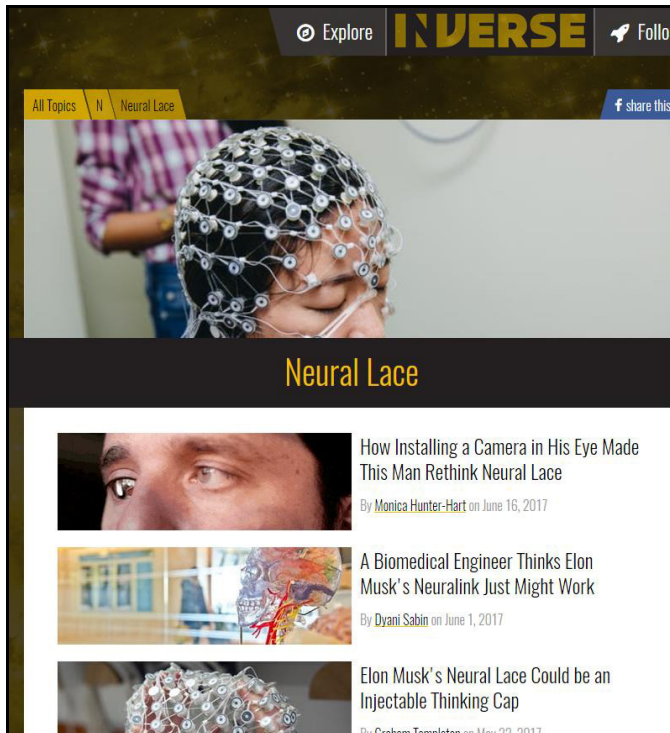


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Elon Musk's Neural Lace Could be an Injectable Thinking Cap  
By Graham Tennison on May 22, 2017

It's time to update that ancient Chinese proverb (or was it a curse?): “May you live in *interesting* times,” to “May you live in *exponential* times!” And we do! With the current pace of exponential change in fields like nanotechnology, biotech and artificial intelligence, it just may be time to listen again to what your elementary school teacher once told you, “Put on you thinking cap.” Only this time you won't put it on, it will be injected!

## Footnotes

a. <http://www.newsmax.com/SciTech/isaac-asimov-predictions/2014/01/06/id/545487>