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Article

NEURALINK: A Brain-Machine Interface Device

Shreyasee Das[1], Rahul Shil[2]*

ABSTRACT

One of the most mysterious biological structures in the natural world is the human brain. Research indicates that advancements in neuroscience and related technology have elevated clinical assessment, diagnostic, and treatment approaches. Nevertheless, there is still far too much to learn about nervous system flaws and diseases. A brand-new breakthrough and progress in the fields of neuroscience and neuro-engineering is being made by the neurotechnology company Neuralink. The most likely goal is to create an implanted brain-machine interface that will improve the quality of life for those suffering from severe spinal cord and brain injuries, along with making a bridge between the human brain and artificial technology. Although preliminary animal experiments showed encouraging results, the final outcome of this technology could be seen within a few years. However, in order to conclude the safety and viability of the neuralink device, further research studies are needed to move beyond speculation.

Keywords: *Neuralink, Brain-Machine Interface Device*

Neuralink is a chip designed to connect the brain with technology to allow humans to wirelessly connect their brains with mobiles or any other device, as well as to find a cure for the most challenging brain diseases, according to Elon Musk. One of the ambitious plans was to implant the chip into the human brain, which was done on an unidentified person. Furthermore, the scientists also aimed to help individuals with various forms of physical disability and enable humans to connect their brains to machines and achieve symbiosis with artificial intelligence.[1] Helping people use their minds to control the movements of an exoskeleton or other robotic devices is one possible advantage for the medical field. Enabling a mindful connection between patients, re-establishing neural connections destroyed in degenerative diseases like Alzheimer's disease, building communication for individuals with conditions like locked-in syndrome, monitoring and developing people's psychophysiological moods and cognitive capacities, as well as helping to cure drug-resistant epilepsy and prevent seizures. Brain-machine interfaces have the potential to help people with a wide range of clinical disorders. Researchers have used only the maximum of 256 electrodes to demonstrate human neuroprosthetic control of robotic limbs, voice synthesizers, and computer cursors. On average, millions of neurons can be recorded through the skull using non-invasive methods. Due to the need for the most

[1]Lecturer, Department of Nursing Sciences, VCON, Harsha Institutions, Bengaluru, India.
[2]Associate Professor & Ph.D. Researcher, Department of MSN (Neuroscience), VCON, Harsha institutions. Bengaluru, India.
*Corresponding Author

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accurate readout of neuronal representations, the majority of brain-machine interfaces have used invasive techniques. Recording single action potential from neurons in distributed functionally linked ensembles.[2] This neural link is built with arrays of small and flexible electrode "threads," with 3072 electrodes per array distributed around 96 threads. Additionally, the scientists have developed a neurosurgery robot that can insert six threads, or 192 electrodes, every minute. The ability of each thread to be individually inserted into the brain with micron-level accuracy will allow the surface vasculature to avoid targeting a particular area of the brain. Neuroscientific norms of neuron physiology provide the foundation for neuralink's use. When enough depolarizing signals are received by neurons, it increments the depolarizing threshold. They elicit the action potential that travels down their axons and causes the release of neurotransmitters that either potentiate or inhibit further signaling. Electrophysiological analysis of this process creates a spike pattern, which can be observed using probes and microelectrode arrays. When exposed to trauma, the efficiency of depolarization can be altered either in frequency, amplitude, or both. Restoration to other areas and structures of the body is far more effective than that of the neurons. Neuronal regeneration has many in vivo processes that are localized to the olfactory sensory system, the dentate gyrus of the hippocampus, and the forebrain subventricular zone. The possibility of regenerating the function of neurons in the peripheral nervous system has improved due to the utilization of surgical procedures such as autografts to enhance functional results. Restoration of functions using BMIs is an aim that is shared not only by neuralink but also by technologies beforehand. Prior to it, the mainstay therapy for movement disorders was DBS. On the basis of the DBS approach, neuralink differ in two major ways: The neuralink neuroprosthetic fiber design offers flexible, thin probes with an abundance of electrodes embedded into the fiber themselves, creating increased biocompatibility in living tissue.[3]

Fig: Neuralink Chip

NEURALINK IMPLANTATION

Thin-film polymers have previously been used for the electrode probes, but their low bending stiffness complicates insertions. Robotic insertion has been developed by neuralink approaching for the insertion of flexible probes, allowing rapid and reliable insertion of the large number of polymer probes targeting to avoid vasculature and record from dispersed brain regions. The robot's insertion head is mounted on a globally accurate 400*400*150 mm travel, 10 µm three-axis tag, and holds a small, quick swappable "needle pincher" assembly. The robot mainly features an auto-insertion mode, which can insert itself into up to six threads. The entire insertion process can be automated, but the surgeon still has complete control and the option to make changes if needed to prevent minute vasculatures on the cortical surface from slowing down the entire insertion time at its quickest rate. Even with these adjustments, the total insertion time for this study averaged approximately 45 minutes for an approximate insertion rate of 29.6 electrodes per minute.[3-5]

Fig: Neuralink surgical robot

RECENT UPDATES

On January 29, 2024, it was announced by Elon Musk that the implantation of neuralink into the human brain as a brain-computer interface will play a vital role in the advancement of neuroscience and neurobiology. This week, Musk said on space that the person on whom this first trial was made is reluctantly in a full recovery zone with no ill effects and is also able to move a mouse around the screen by just thinking 5. While the human implantation was done and recruitment was going on for a large sample clinical trial, the scientists discovered that this device has potential in the treatment of Parkinson disease.[6]

CONCLUSION

It is too soon to say whether or not neuralink will be effective in treating neurological disorders or not. However, this device can be a lead for science to do more research on the brain. There were some controversies arising regarding the animal experimentation, but the report says that there were no deaths of any animals during the trial. Moreover, if this neural link gets a success, then it can bring a huge advancement in the fields of neurobiology and neuroscience. It will raise the potential in neuroamplification and also the treatment modalities, which will give rise to hopeful advancements in improving the lives of people with spinal cord injury, neurodegenerative disorders, and neurobiological shortfalls across the world. To date, only some assumptions can be made regarding the safety and efficacy of the device. The whole process requires further investigation and study. Additionally, these clinical trials, which are being made now where man can control the mouse, can bring a great advancement in this perspective. Additionally, the exact prediction of the future of neuralink can only be made after the release of the trial data.

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Conflict of Interest

The author(s) declared no conflict of interest.

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