Human Interaction Model I

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Topic

Human evolution has rounded a corner by relying on technological advancements rather than natural selection to continue adapting. The neural implant is one prime example of one such advancement that could be used to propel human evolution to the next stage. A neural implant is a brain-computer interface device that can interpret brain waves and translate them to directions for manipulatable external tools or for analyzing and guiding internal processes. Studying neural implants and their applications are worthy of further investigation because the effects of debilitating neurological conditions and physical conditions can be effectively alleviated or possibly eradicated using a brain implant (Gulino et al., 2019). It can allow victims of paralysis to potentially regain lost control over limbs, ease the ailments of disorders like Parkinson's or Alzheimer's, and overall increase quality of life for all (Gulino et al., 2019). In modeling and simulation, brain implants can have significant progressive ramifications. An enhanced capability for metacognition and self-awareness, can provide us with greater insights into human problem solving, learning, information processing, and more (Gulino et al., 2019). The synthesis of these insights can yield greater utility into a variety of fields like healthcare, education, business, etc. Finally, neural implants can increase our ability to control and influence technology ultimately removing the barriers between the human mind and the computer. New technological advancements, like decoding thoughts and allowing for their upload and download to convey information can spawn from these endeavors, creating a positive feedback loop between human insights, social applications, and technological advancements (Gulino et al., 2019).

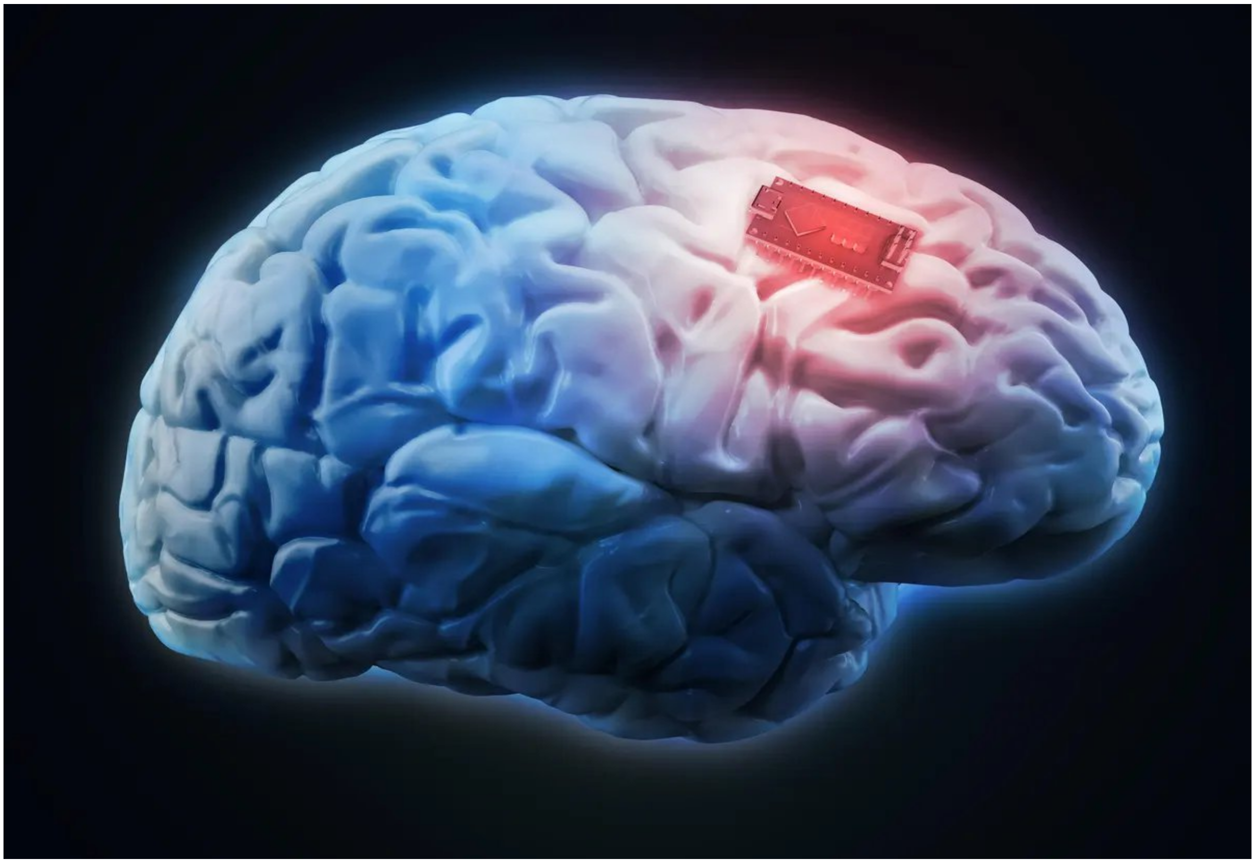

Figure 1

Neural Implant In Veteran's Brain

From *Neural revolution': Royal Society calls for inquiry into new wave of brain implants*, by I. Sample, 2019, The Guardian.

Human

The individual being considered for my model is a 35-year-old veteran who recently suffered a spinal cord injury in combat that caused paralysis of his lower limbs. The injury occurred three months prior, and he has suffered muscle atrophy because of his inability to use his legs. The amount of atrophy endured has been minimal and his legs remain capable of holding his weight up. In the three months since his accident, the veteran has gotten around through the use of an electric wheelchair that he steers. During his time in the Navy, the veteran had experience with brain-computer interfaces, often using augmented and virtual reality in combat training. He also has no previous experience using a walker. He has a basic understanding of computer hardware and software from his employment with the Navy, but also through a passive interest in technology. Consequently, the veteran is well acquainted with smartphone applications and their formatting. He has no familiarity with the neural implant recently embedded in his brain, nor the brain-computer interface or the smartphone application that comes with it. Finally, he has worked with the present physical therapist in the past, and he has a history of attending physical therapy.

Task & Context

The veteran will begin by using his neural implant to regain control over his lost limbs for the first time. Because this is his first time using it, there will be a period where he must relearn how to walk again. To prevent injury, he is using a walker to stabilize himself. The veteran will be using a smartphone application that can displays readings from the neural implant. The readings include a step counter, connection signal, and a frequency chart that measures brain waves. The neural implant also relays patient vitals to the app, allowing the veteran to view his BPM, oxygen intake, blood pressure, and body temperature. This activity will require him to read data from the application and ensure the connection is smooth and data is being properly transferred to the smartphone. The veteran is performing all the tasks in a physical therapy room, under the guidance of a physical therapist. He will be using a current generation iPhone and both the neural implant, and its accompanying smartphone application will be created by the same company. The setting is relatively informal, as its mostly an individual task, but the physical therapist is present to prevent injury and to ensure that proper diligence is given to the task. Overall, the veteran will demonstrate learning by reteaching himself how to walk, assessing by utilizing his smartphone application to analyze brain readings, decision-making and problem-solving if any errors are to occur, and finally minor amounts of programming to get the app to work properly with his neural implant.

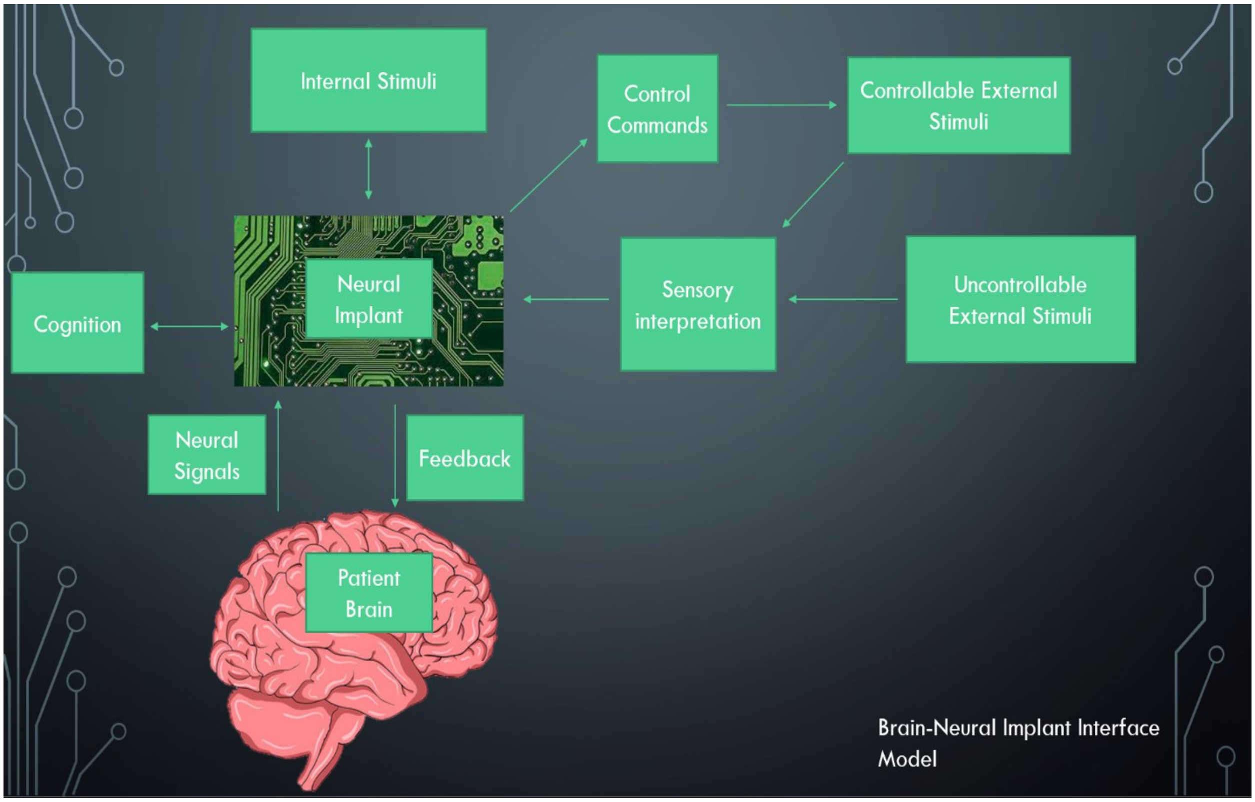

Figure 2

Brain-Neural Implant Interface Model

From *Brain-computer interfaces in medicine,* by Shih, J.J. et al., 2012, Mayo Clinic Proceedings.

Model Description

The model starts with the patient's brain. It is both the starting and finishing point of the model. The veteran's brain is augmented through its intricate connection with the neural implant, the key component of the model. The neural implant acts as a buffer between the brain and any of its traditional functions – receiving and decoding internal stimuli, sensory interpretations from external stimuli, and cognition. Both the brain and the neural implant work in tandem for the veteran to complete the task of exercising control over his formerly paralyzed limbs. During the task, the veteran's brain will send electrical impulses to the implant via neural pathways. These impulses could issue directions to the neural implant to move a limb, connect to his smartphone, or heighten his ability to think or reason The neural implant then deciphers those impulses and then disperses these commands accordingly. This interaction is characterized by the neural signals element on Figure 1. The neural implant provides feedback from internal and external stimuli and cognitive processes to the brain via the same neural pathways, denoted on Figure 1 by the feedback box. The first element connected to the neural implant is cognition. The cognition element represents all the patient's cognitive processes – problem-solving, imagination, memory, perception, etc. The neural implant enhances cognition by sharpening these processes and increasing their respective speeds and efficacy. This helps the veteran during the task by giving him a heightened window for reacting to decisions, better problem-solving skills, and an elevated awareness of his own thought processes. After influencing the strength and speed of cognition, information is returned to the neural implant and ultimately relayed to the brain as well. The arrows between cognition and the neural implant define this relationship. The internal stimuli construct represents any information relayed to the neural implant via internal systems. Any internal stimuli: the nervous system, hunger, etc. all alert the brain through the neural implant. It also communicates internally, by sending electrical impulses down the nervous system to control a formerly dead limb. This characterizes his brain's newfound ability to command his previously immobile limb during the task. Much like cognition, any data received from internal stimuli is routed first through the neural implant then alerting the brain. Similarly, the implant also interacts with external stimuli. Control signals are sent from the neural implant to connect to and influence controllable external stimuli. Controllable external stimuli include anything wirelessly accessible by the neural implant such as the cell phone application used by the veteran to examine the implant's readings. This indicates his ability to wirelessly couple himself with the smartphone app connected to his neural implant. Uncontrollable external stimuli, on the other hand, describes any stimuli not manipulatable by the neural implant. Examples include any external bodies that cannot be controlled by the neural implant such as chairs, the veteran's walker, and anything else in the physical therapy room that doesn't have technological properties. All external stimuli are interpreted by sensory organs before returning to the neural implant as information. This is denoted by the sensory interpretation box on Figure 2. All information from sensory organs – touch, taste, smell, hearing, seeing is routed through the neural implant before being returned to the brain. The sensory interpretation box is connected to both the uncontrollable and controllable external stimuli elements because when the veteran communicates with controllable external stimuli like his smartphone, his eyes and ears are providing information to his brain by way of the neural implant. The same can be said when he speaks with his physical therapist or touches his walker to help him walk, both uncontrollable external stimuli whose interaction yields sensory information. As previously mentioned, the model concludes with the feedback box. The feedback box designates any data returned to the neural implant from any of the other components of the model – cognition, internal stimuli, external stimuli. The neural implant communicates with the brain along the same neural pathways as the model begins with. It is distinct from the neural signals stemming from the brain because those are orders given to the neural implant, whereas feedback is returning information that the brain processes. This provides the veteran with details from his sensory organs, his cognitive processing centers, or his internal figures.

References

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