**BRAIN IMPLANT: USING THE COMPUTER SYSTEM**

**ABSTRACT**

A Brain implant (brain-machine interface) is a communication system that does not depend on the brains normal output pathways of peripheral nerves and muscles. It is a new communication link between a functioning human brain and the outside world. These are electronic interfaces with the brain, which has the ability to send and receive signals from the brain. BMI uses brain activity to command, control, actuate and communicate with the world directly through brain integration with peripheral devices and systems. The signals from the brain are taken to the computer via the implants for data entry without any direct brain intervention. BMI transforms mental decisions and/or reactions into control signals by analyzing the bioelectrical brain activity.

**HISTORICAL BACKGROUND OF THE STUDY**

In 1870, [Eduard Hitzig](http://en.wikipedia.org/wiki/Eduard_Hitzig) and Gustav Fritsch demonstrated that electrical stimulation of the brains of dogs could produce movements. [Robert Bartholow](http://en.wikipedia.org/wiki/Robert_Bartholow) showed the same to be true for humans in 1874. By the start of the 20th century, Fedor Krause began to systematically map human brain areas, using patients that had undergone [brain surgery](http://en.wikipedia.org/wiki/Brain_surgery).

Prominent research was conducted in the 1950s. [Robert G. Heath](http://en.wikipedia.org/wiki/Robert_Galbraith_Heath) experimented with aggressive mental patients, aiming to influence his subjects' moods through electrical stimulation.[[22]](http://en.wikipedia.org/wiki/Brain_implant#cite_note-22)

Yale University physiologist [Jose Delgado](http://en.wikipedia.org/wiki/Jos%C3%A9_Manuel_Rodriguez_Delgado) demonstrated limited control of animal and human subjects' behaviours using electronic stimulation. He invented thestimoceiver or transdermal stimulator, a device implanted in the brain to transmit electrical impulses that modify basic behaviours such as aggression or sensations of pleasure.

Delgado was later to write a popular book on mind control, called Physical Control of the Mind, where he stated: "the feasibility of remote control of activities in several species of animals has been demonstrated [...] The ultimate objective of this research is to provide an understanding of the mechanisms involved in the directional control of animals and to provide practical systems suitable for human application."

# INTRODUCTION:

# BRAIN IMPLANT

**Brain implants**, often referred to as **neural implants**, are technological devices that connect directly to a biological subject's [brain](http://en.wikipedia.org/wiki/Brain) - usually placed on the surface of the brain, or attached to the [brain](http://en.wikipedia.org/wiki/Brain)'s [cortex](http://en.wikipedia.org/wiki/Cerebral_cortex). A common purpose of modern brain implants and the focus of much current research is establishing a [biomedical](http://en.wikipedia.org/wiki/Biomedical) prosthesis circumventing areas in the brain that have become dysfunctional after a [stroke](http://en.wikipedia.org/wiki/Stroke) or other [head injuries](http://en.wikipedia.org/wiki/Head_injury). This includes [sensory substitution](http://en.wikipedia.org/wiki/Sensory_substitution), e.g., in [vision](http://en.wikipedia.org/wiki/Visual_perception). Other brain implants are used in animal experiments simply to record brain activity for scientific reasons. Some brain implants involve creating interfaces between [neural systems](http://en.wikipedia.org/wiki/Biological_neural_network) and [computer chips](http://en.wikipedia.org/wiki/Integrated_circuit). This work is part of a wider research field called [brain-computer interfaces](http://en.wikipedia.org/wiki/Brain-computer_interface). (Brain-computer interface research also includes technology such as [EEG](http://en.wikipedia.org/wiki/Electroencephalography) arrays that allow interface between mind and machine but do not require direct implantation of a device.)

Neural-implants such as [deep brain stimulation](http://en.wikipedia.org/wiki/Deep_brain_stimulation) and [Vagus nerve stimulation](http://en.wikipedia.org/wiki/Vagus_nerve_stimulation) are increasingly becoming routine for patients with [Parkinson's disease](http://en.wikipedia.org/wiki/Parkinson%27s_disease) and [clinical depression](http://en.wikipedia.org/wiki/Clinical_depression) respectively, proving themselves as a boon for people with diseases which were previously regarded as incurable.

**THE HUMAN BRAIN**

According to the new approach biology, the human brain is the most specialized organ of the human body weighing about 1.4kg, it is compose of millions of nerve cell called neuron.

Robin Hureley and G K Schalk of neuron and laboratory, the brain is undoubtedly the base life form. All of it happens in the brain, so complex it is that we are only vague information about how it works. The average human brain weights about 1400gm. The most relevant part of brain concerning BMI‘s is the cerebral cortex. The cerebral cortex can be divided into two hemispheres. The hemispheres are connected with each other via corpus callosum. Each hemisphere can be divided into four lobes. They are called frontal, parietal, occipital and temporal lobes. Cerebral cortex is responsible for many higher order functions like problem solving, language comprehension and processing of complex visual information. The cerebral cortex can be divided into several areas, which are responsible of different functions. This kind of knowledge has been used when with BCI‘s based on the pattern recognition approach. The mental tasks are chosen in such a way that they activate different parts of the cerebral cortex.

|  |  |
| --- | --- |
| Cortical Area | Function |
| Auditory Association Area | Processing of auditory information |
| Auditory Cortex | Detection of sound quality (loudness, tone) |
| Speech Center (Broca‘s area) | Speech production and articulation |
| Prefrontal Cortex | Problem solving, emotion, complex thought |
| Motor Association Cortex | Coordination of complex movement |
| Primary Motor Cortex | Initiation of voluntary movement |
| Primary Somatosensory Cortex | Receives tactile information from the body |
| Sensory Association Area | Processing of multisensory information |
| Visual Association Area | Complex processing of visual information |
| Wernicke‘s Area | Language comprehension |
| Primary Somatosensory Cortex | Receives tactile information from the body |
| Sensory Association Area | Processing of multisensory information |

Table.1 Cortical areas of the brain and their function

**BRAIN MACHINE INTERFACE**

A brain-machine interface (BMI) is an attempt to mesh our minds with machines. It is a communication channel from a human's brain to a computer, which does not resort to the usual human output pathways as muscles. It is about giving machine-like capabilities to intelligence, asking the brain to accommodate synthetic devices, and learning how to control those devices much the way we control our arms and legs today. These experiments lend hope that people with spinal injuries will be able to use their brain to control a prosthetic limb, or even their own arm. A BMI could, e.g., allow a paralyzed patient to convey her/his intentions to a computer. But also applications in which healthy users can benefit from the direct brain computer communication are conceivable, e.g., to speed up reaction times. Initially theses interactions are with peripheral devices, but ultimately it may be interaction with another brain. The first peripheral devices were robotic arms. Our approach bases on an artificial neural network that recognizes and classifies different brain activation patterns associated with carefully selected mental tasks. Using BMI artificial electrical signal can stimulate the brain tissue in order to transmit some particular sensory information.

**BLOCK DESCRIPTION OF BRAIN MECHINE INTERFACE**

The BMI consists of several components:

1. The implant device, or chronic multi-electrode array,

2. The signal recording and processing section,

3. An external device the subject uses to produce and control motion and

4. A feedback section to the subject.

The first component is an implanted array of microelectrodes into the frontal and parietal lobes areas of the brain which involved in producing multiple output commands to control complex muscle movements. This device record action potentials of individual neurons and then represent the neural signal using a rate code .The second component consists of spike detection algorithms, neural encoding and decoding systems, data acquisition and real time processing systems etc. The external device that the subject uses may be a robotic arm, a wheel chair etc. depending upon the application. Feedback is an important factor in BCI‘s. In the BCI‘s based on the operant conditioning approach, feedback training is essential for the user to acquire the control of his or her EEG response. However, feedback can speed up the learning process and improve performance.

**BMI COMPONENTS**

A brain-machine interface (BMI) in its scientific interpretation is a combination of several hardware and software components trying to enable its user to communicate with a computer by intentionally altering his or her brain waves. The task of the hardware part is to record the brainwaves– in the form of the EEG signal – of a human subject, and the software has to analyze that data. In other words, the hardware consists of an EEG machine and a number of electrodes scattered over the subject‘s skull. The EEG machine, which is connected to the electrodes via thin wires, records the brain-electrical activity of the subject, yielding a multi-dimensional (analog or digital) output. The values in each dimension (also called channel) represent the relative differences in the voltage potential measured at two electrode sites.

The software system has to read, digitize (in the case of an analog EEG machine), and preprocess the EEG data (separately for each channel), to understand the subject‘s intentions, and generate appropriate output. To interpret the data, the stream of EEG values is cut into successive segments, transformed into a standardized representation, and processed with the help of a classifier. There are several different possibilities for the realization of a classifier; one approach involving the use of an artificial neural network (ANN) has become the method of choice in recent years.

**ELECTROENCEPHALOGRAPHY**

Electroencephalography (EEG) was invented by Hans Bergers in 1929, and it was later modify by Mia Romeo in 2011. It is used in measuring the electrical activity of the brain. Electrodes are placed on the person head and lends (wires) are hooked up to a computer, the computer tracks the person brain activity in a graphed. And EEG can be use to diagnose epilepsy, stroke, mental stability in a person etc. The EEG test will be read by a train doctor of neurologist. The EEG was mainly created to measure brain waves of a person.

As time passed, more neurologist discovered several brain malfunctioning, and checking for problems with loss of consciousness or determined and helped to find out a person chance of recovery after a change in consciousness.

The EEG signal can be picked up with electrodes either from scalp or directly from the cerebral cortex. As the neurons in our brain communicate with each other by firing electrical impulses, this creates an electric field which travels though the cortex, the dura, the skull and the scalp. The EEG is measured from the surface of the scalp by measuring potential difference between the actual measuring electrode and a reference electrode.

The peak-to-peak amplitude of the waves that can be picked up from the scalp is normally 100 microV or less while that on the exposed brain, is about 1mV. The frequency varies greatly with different behavioral states. The normal EEG frequency content ranges from 0.5 to 50 Hz.

Frequency information is particularly significant since the basic frequency of the EEG range is classified into five bands for purposes of EEG analysis. These bands are called brain rhythms and are named after Greek letters.

Five brain rhythms are displayed in Table.2. Most of the brain research is concentrated in these channels and especially alpha and beta bands are important for BCI research. The reason why the bands do not follow the Greek letter magnitude (alpha is not the lowest band) is that this is the order in which they were discovered.

|  |  |
| --- | --- |
| Band | Frequency [Hz] |
| Delta | 0.5- 4 |
| Theta | 4- 8 |
| Alpha | 8- 13 |
| Beta | 13- 22 |
| Gamma | 22-30 |

Table.2.Common EEG frequency ranges

The alpha rhythm is one of the principal components of the EEG and is an indicator of the state of alertness of the brain.

**BRAIN GATE**

**Brain Gate** is a brain implant system developed by the bio-tech company Cyberkinetics in 2003 in conjunction with the Department of Neuroscience at Brown University. The device was designed to help those who have lost control of their limbs, or other bodily functions, such as patients with amyotrophic lateral sclerosis (ALS) or spinal cord injury. The computer chip, which is implanted into the brain, monitors brain activity in the patient and converts the intention of the user into computer commands.

Currently the chip uses 100 hair-thin electrodes that sense the electro-magnetic signature of neurons firing in specific areas of the brain, for example, the area that controls arm movement. The activity is translated into electrically charged signals and are then sent and decoded using a program, which can move either a robotic arm or a computer cursor.

According to the Cyberkinetics' website, three patients have been implanted with the BrainGate system. The company has confirmed that one patient (Matt Nagle) has a spinal cord injury, whilst another has advanced ALS.

In addition to real-time analysis of neuron patterns to relay movement, the Braingate array is also capable of recording electrical data for later analysis. A potential use of this feature would be for a neurologist to study seizure patterns in a patient with epilepsy.

Cyber kinetics has a vision, CEO Tim Surgenor explained to Gizmag, or that quadriplegic people will be able to walk again - yet. Their primary goal is to help restore many activities of daily living that are impossible for paralysed people and to provide a platform for the development of a wide range of other assistive devices.

"Today quadriplegic people are satisfied if they get a rudimentary connection to the outside world. What we're trying to give them is a connection that is as good and fast as using their hands. We're going to teach them to think about moving the cursor using the part of the brain that usually controls the arms to push keys and create, if you will, a mental device that can input information into a computer. That is the first application, a kind of prosthetic, if you will. Then it is possible to use the computer to control a robot arm or their own arm, but that would be down the road."

Existing technology stimulates muscle groups that can make an arm move. The problem Surgenor and his team faced was in creating an input or control signal. With the right control signal they found they could stimulate the right muscle groups to make arm movement.

"Another application would be for somebody to handle a tricycle or exercise machine to help patients who have a lot of trouble with their skeletal muscles. But walking, I have to say, would be very complex. There's a lot of issues with balance and that's not going to be an easy thing to do, but it is a goal."

Surgenor also sees a time not too far off where normal humans are interfacing with BrainGate technology to enhance their relationship with the digital world - if they're willing to be implanted.

"If we can figure out how to make this device cheaper, there might be applications for people to control machines, write software or perform intensive actions. But that's a good distance away. Right now the only way to get that level of detail from these signals is to actually have surgery to place this on the surface of the brain.

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Dummy unit illustrating the design of a Brain Gate interface

**ETHICAL CONSIDERATION**

Who are good candidates to receive neural implants? What are the good uses of neural implants and what are the bad uses? Whilst [deep brain stimulation](http://en.wikipedia.org/wiki/Deep_brain_stimulation) is increasingly becoming routine for patients with Parkinson's disease, there may be some behavioural side effects. Reports in the literature describe the possibility of apathy, hallucinations, compulsive gambling, hypersexuality, cognitive dysfunction, and depression. However, these may be temporary and related to correct placement and calibration of the stimulator and so are potentially reversible.[[23]](http://en.wikipedia.org/wiki/Brain_implant#cite_note-23)

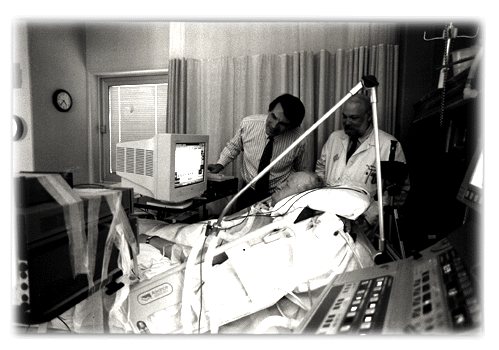
Some [transhumanists](http://en.wikipedia.org/wiki/Transhumanism), such as [Raymond Kurzweil](http://en.wikipedia.org/wiki/Raymond_Kurzweil) and [Kevin Warwick](http://en.wikipedia.org/wiki/Kevin_Warwick), see brain implants as part of a next step for humans in progress and [evolution](http://en.wikipedia.org/wiki/Evolution), whereas others, especially [bioconservatives](http://en.wikipedia.org/wiki/Bioconservative), view them as [unnatural](http://en.wikipedia.org/wiki/Appeal_to_nature), with humankind losing essential [human](http://en.wikipedia.org/wiki/Human) qualities. It raises controversy similar to other forms of [human enhancement](http://en.wikipedia.org/wiki/Human_enhancement). For instance, it is argued that implants would technically change people into cybernetic organisms ([cyborgs](http://en.wikipedia.org/wiki/Cyborgs)). It's also given that all research is to comply to the Helsinki-declaration. Yet further, the usual legal duties apply such as information to the person wearing implants and that the implants are voluntary, with (very) few exceptions.

**BRIAN IMPLANT IN FICTION AND PHYSILOSOPHY**

According to Hilary Putnam 's a great philosophers in (1981), Putnam argument of the brain in a vat , he argues that brains, being directly fed with an input from a computer (instead of reality ), would have no chance of detecting the deception.

Not until the popular 1999 film The Matrix , and its sequels, The Matrix Reloaded and The Matrix Revolutions , both in 2003, have expanded upon this argument, positing a world where BMI machine have conquered humanity and placed the bodies in arrays to use for power, and are keeping them alive by immersing their minds in a computer -based constructed reality.

The neurotrophic electrode is implanted into the motor cortex of the brain using a tiny glass encasing. Neurotrophic growth factors are implanted into the glass, and the cortical cells grow into the electrode and form contacts. It takes several weeks for the cortical tissue to grow into the electrode. The neurons in the brain transmit an electronic signal when they "fire." Recording wires are placed inside the glass cone to pick up the neural signals from the ingrown brain tissue and transmit them through the skin to a receiver and amplifier outside of the scalp.



**APPLICATIONS**

The BMI technologies of today can be broken into three major areas:

1. Auditory and visual prosthesis:

- Cochlear implants

- Brainstem implants

- Synthetic vision

- Artificial silicon retina

2. Functional-neuromuscular stimulation (FNS) :

FNS systems are in experimental use in cases where spinal cord damage or a stroke has severed the link between brain and the peripheral nervous system. They can use brain to control their own limbs by this system

3. Prosthetic limb control:

i. Thought controlled motorized wheel chair.

ii. Thought controlled prosthetic arm for amputee.

iii. Various neuroprosthetic devices

Other various applications are Mental Mouse Applications in technology products, e.g., a mobile phone attachment that allows a physically challenged user to dial a phone number without touching it or speaking into it. System lets you speak without saying a word in effective construction of unmanned systems, in space missions, defense areas etc. NASA and DARPA have used this technology effectively. Communication over internet can be modified.

**4.1 FUTURE EXPANSION**

A new thought-communication device might soon help severely disabled people get their independence by allowing them to steer a wheelchair with their mind. Mind-machine interfaces will be available in the near future, and several methods hold promise for implanting information. . Linking people via chip implants to super intelligent machines seems to a natural progression –creating in effect, super humans. These cyborgs will be one step ahead of humans. And just as humans have always valued themselves above other forms of life, it is likely that cyborgs look down on humans who have yet to ‗evolve‘.

Will people want to have their heads opened and wired? Technology moves in light speed now. In that accelerated future, today‘s hot neural interface could become tomorrow‘s neuro trash. Will you need to learn any math if you can call up a computer merely by your thoughts? Thought communication will place telephones firmly in the history books.

**PURPOSE**

Brain implants electrically stimulate, block or record (or both record and stimulate simultaneously signals from single [neurons](http://en.wikipedia.org/wiki/Neuron) or groups of neurons ([biological neural networks](http://en.wikipedia.org/wiki/Biological_neural_network)) in the brain. The blocking technique is called intra-abdominal vagal blocking.[[1]](http://en.wikipedia.org/wiki/Brain_implant#cite_note-medscape.com-1) This can only be done where the functional associations of these neurons are approximately known. Because of the complexity of neural processing and the lack of access to [action potential](http://en.wikipedia.org/wiki/Action_potential) related signals using [neuroimaging](http://en.wikipedia.org/wiki/Neuroimaging)techniques, the application of brain implants has been seriously limited until recent advances in neurophysiology and computer processing power.

**ADVANTAGES**

Depending on how the technology is used, there are good and bad effects

1. In this era where drastic diseases are getting common it is a boon if we can develop it to its

full potential.

2. Also it provides better living, more features, more advancement in technologies etc.

3. Linking people via chip implants to super intelligent machines seems to a natural progression

creating in effect, super humans.

4. Linking up in this way would allow for computer intelligence to be hooked more directly into

the brain, allowing immediate access to the internet, enabling phenomenal math capabilities

and computer memory.

5. By this humans get gradual co-evolution with computers.

6, it enable those with parkinsons disease work and move their limbs effectively via computer

**CHALLENGES**

1. Connecting to the nervous system could lead to permanent brain damage, resulting in the loss

of feelings or movement, or continual pain.

2. In the networked brain condition –what will mean to be human?

3. Virus attacks may occur to brain causing ill effects.

4. it is very high to afford the brain implant machine (BIM / BCI)

**5. SUMMARY / CONCLUSION**

Cultures may have diverse ethics, but regardless, individual liberties and human life are always valued over and above machines. What happens when humans merge with machines? The question is not what will the computer be like in the future, but instead, what will we be like? What kind of people are we becoming?

BMI‘s will have the ability to give people back their vision and hearing. They will also change the way a person looks at the world. Someday these devices might be more common than keyboards. Is someone with a synthetic eye, less a person than someone without? Shall we process signals like ultraviolet, X-rays, or ultrasounds as robots do? These questions will not be answered in the near future, but at some time they will have to be answered. What an interesting day that will be.

**RECOMMENDATION**

in the above study, effort should be made for those people who are suffering from mental stability, physical disorder and intellectually problems are hereby recommended to use brain implants machine or device in order to enable them regain their loss of hope. And also government should also make available the brain implant device or machine to hospitals in Nigeria to help those with brain related problem in solving solution.

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