NEXT GENERATION SCIENCE - BRAIN COMPUTER INTERFACE

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1. Abstract

Brain computer interface (BCI) in next generation science that developing by scientist and researchers. Basically BCI is combination of various sciences and concepts i.e.

⇒ Neuroscience and
⇒ Computer Science
⇒ Artificial Intelligence etc

BCI is related with technical interfacing with brain and the computer. How brain thinks, and how various changes are occur in brain? Such changes are observed by various techniques and one conclusion is determined. Computer now start making assuming by various complex calculation that what is specific kind or changes done in brain and what is interpretation of that what should be , it would very beneficial.

response over that. The whole process is known as Brain-Computer interfacing. Although this process is not easy as we talking like. There are numerous limitation, difficulty and problems. But if computer start understanding human brain there is no longer that human life become

brain is sending signal

even more comfortable and more value can be added in all sector of standard of living and in each field and especially in healthcare

2. Overview

Brain Computer System basically aims to identify few patterns which come out of the brain.

In this modern era, as the power of modern computes grows alongside our understanding of brain.

We often see spectacular science fiction but do we ever imagine if it possible to make it realty, yes, some miracle may knocking the door, imagine transmitting signals directly to someone's brain that would allow them to see, hear or feel specific sensory inputs. Consider the potential to manipulate computers or machinery with nothing more than a thought. It isn't about convenience for severely disabled people; development of a brain-computer interface (BCI) could be the most important technological breakthrough in decades

So Brain Computer interface is very revalorizing science that may change life of some people entirely suffering from heavy pain and disabilities.

Let's take example of a man

That could not walk; move and can not do any movement related work. Now if we merge intelligence along with BCI we can develop machines that can artificially intelligent and can understood what need of the physically disabled people needs is and put some extra logic with it and help them.

For example a man wants to go downwards to hall from the first flour a BCI enabled chair may be helpful by taking him at downward. It also not just follow the intension of that men but it can consider his objective and also face obstacles coming ahead e.g. it has to go from the stairs. Clinical researcher and neurologist are now trying to develop such chairs and can soon help such disabled people. So, we can say that BCI upcoming concept that can be

Clinical researchers & Neuroscientists are trying to make BCi enabled wheel chairs that target to disabled user to make their life easy

BRAIN COMPUTER INTERFACE - BCI

change life of all the people.
BRAIN COMPUTER INTERFACE (BCI)

3. What is Brain Computer Interface (BCI)?

"A direct technological interface between a brain and a computer not requiring any physical input from the user"

$\Rightarrow$ Brain-Computer Interfaces (BCI)
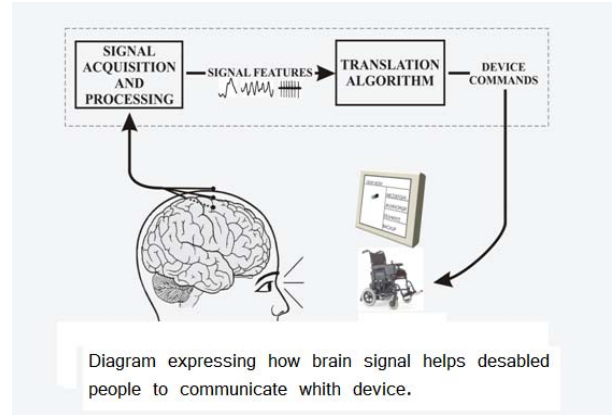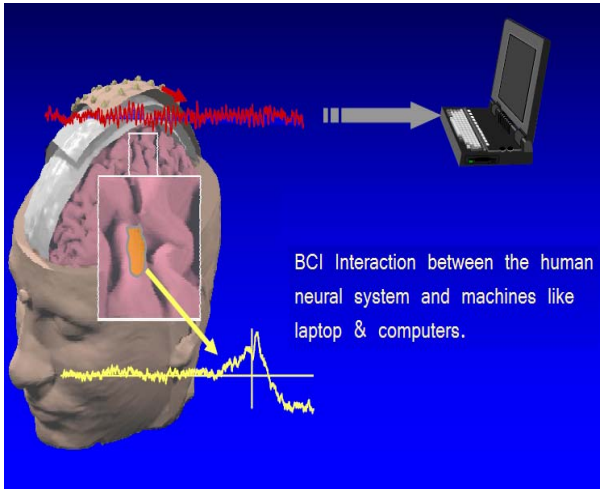 $\rightarrow$ Interaction between the human neural system and machines
$\Rightarrow$ Goal

BCI Interaction between the human neural system and machines like laptop & computers.

Diagram expressing how brain signal helps desabled people to communicate whith device.

→ Enabling people (especially disabled) to communicate and control devices by mere thinking.

BCI Control System:

⇒ One-way BCI
 → Computers either accept commands from the brain or send signals to it (for example, to restore vision) but not both.

⇒ Two-way BCIs
 → Brains and external devices exchanges information in both directions, not yet fully implemented

Over the last two decades, brain-computer interface (BCI) has emerged as a new frontier in assistive technology (AT) since it could provide an alternative communication channel between a user's brain and the outside world. Other terms that are also used in the literature for referring to a BCI system include:

⇒ Brain interface (BI)
⇒ Direct Brain Interface (DBI)
⇒ Brain Machine Interface (BMI).

A BCI system allows individuals with motor disabilities to control objects in their environments (such as a light switch in their room or television, wheelchairs, neural prosthesis and computers) using their brain signals only. This could be accomplished by measuring specific features of the user's brain activity that relate to his/her intent to perform the control. This specific type of brain activity is termed a "neurological phenomenon". /
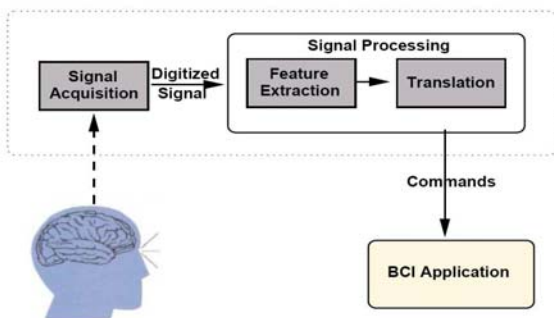
With every thought our brain change its state...
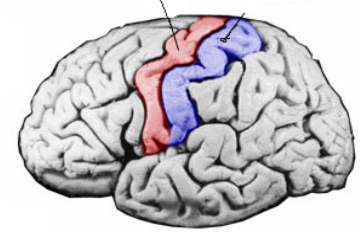
4. How BCI works?

The reason a BCI works at all is because of the way our brains function. Our brains are filled with neurons, individual nerve cells connected to one another by dendrites and axons. Every time we think, move, feel or remember something, our neurons are at work. That work is carried out by small electric signals that zip from neuron to neuron as fast as 250 mph [source: Walker]. The signals are generated by differences in electric potential carried by ions on the membrane of each neuron. Although, the paths the signals take

5. Reading the Brain…

[a] Direct Neural Contact
⇒ It is highly accurate and at some extent reliable technique for reading

Figure 2 : Brain Computer Interface Working

"A system for **controlling a device** e.g. computer, wheelchair or a neuroprothesis by human intention which does not depend on the brain's normal output pathways of peripheral nerves and muscles"

are insulated by something called myelin, some of the electric signal escapes. Scientists can detect those signals, interpret what they mean and use them to direct a device of some kind. It can also work the other way around.

The working of brain is unknown process. Researchers are now thing to find out these unsolved questions. There are numerous types and techniques are used to make Brain computer interface. The whole process of interfacing with the brain is related with these techniques. Let's check out some type of BCI techniques for reading instruction and thoughts in next section.
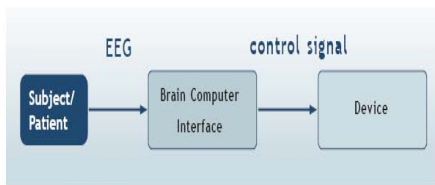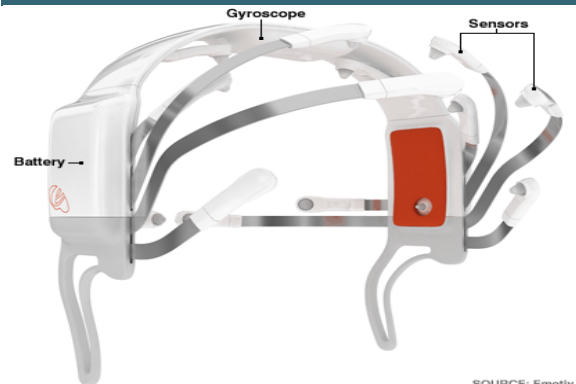
the brain
⇒ Highly invasive
⇒ Not possible with current technologies
⇒ Perhaps possible in future with e.g. nanobots

FIGURE 1 : THOUGHT-CONTROLLED HEADSET

Sensors respond to the electrical impulses behind different thoughts; enabling a user's brain to influence computer directly-
Conscious thoughts, facial expressions, and non-conscious emotions can all be detected
Gyroscope enables a cursor or camera to be controlled by head movements
The headset uses wi-fi to connect to a computer
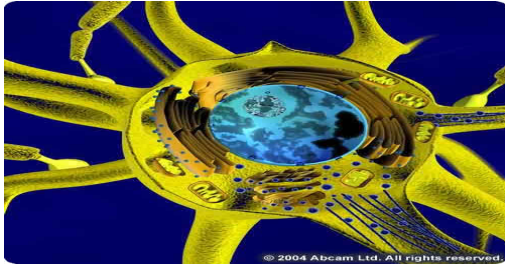
[b] Electroencephalogy (EEG)

Measures electrical activity happening in brain

- ⇒ Non-invasive
- ⇒ Susceptible to noise
- ⇒ Easy to use plus low cost plus portable
- ⇒ Most commonly used device in BCI

[c] Magnetoencephalogy (MEG)

- ⇒ Measures blood flow in brain using MRI (haemodynamics)
- ⇒ Blood flow correlates to neural activity
- ⇒ Studies the brain's function

[d] Functional Magnetic Resonance Imaging (fMRI)

- ⇒ Measures blood flow in brain using MRI (haemodynamics)
- ⇒ Blood flow correlates to neural activity
- ⇒ Studies the brain's function
- ⇒ Very accurate
- ⇒ Very high costs due to MRI

6. BCI Applications

- ⇒ <u>Industry</u>
    - No human labour, raised brains work
- ⇒ <u>Entertainment & Personal Reality</u>
    - Video games
- ⇒ <u>Telepathy & Mind Control</u>
    - Exchange thoughts and Feelings
- ⇒ <u>Intellect & Body Amplifiers</u>
    - Even more power, less efforts
- ⇒ <u>Virtual Body</u>
    - Free and eternal life
    - No biological body
    - No selfish animal instincts
    - Human ideals instead
- ⇒ <u>Collective Intelligence</u>
    - More efficient way to collect intelligence
- ⇒ <u>Human enhancement</u>
    - Cybernetic Organisms
    - Brainwave Synchronization
    - Exocortex(intelligence booster)
- ⇒ <u>Human manipulation</u>
    - Mind-Control
    - Neurohacking

- − Reading of information from the brain
⇒ <u>Medical application</u>
  - − Possibly only communication
  - − Channel for people suffering From e.g. paraplegia, amyotrophic
⇒ <u>Mobile BCI system:</u>
  - − Video games
  - − Increase in theta activity (4-7
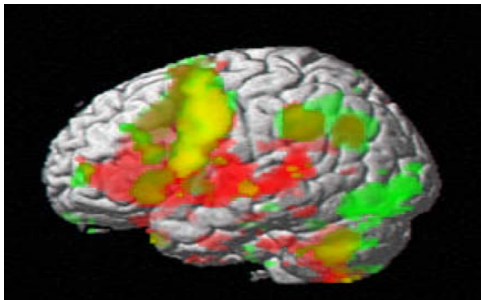
  - − Hz) is associated with recognition memory
  - − Improve arithmetic performance
  - − Improve cognitive performance
⇒ <u>Others</u>
  - − Enabling disabled people
  - − Vision and hearing
  - − Paralysis treatment
  - − Prosthetic devices (legs, hands etc)
  - − Psychotherapy
  - − Diagnostics
  - − Treatment
  - − Military and civil research
  - − Making dangerous jobs

7. Conclusion

Brain Computer interface is very much deep subject and also interesting because there are numerous thing that are unknown and all that things are like miracle happening. BCI can make remarkable change in our life. Researchers are trying to understand the brain and have made number or devices, tools and techniques that able us to know what brain is thing and how we can refer to it. Brain Computer Interface is step that can change our future.

So, we have to just think all thing what we need. If you think, "Oh, I need Coffee at this time…!" A machine like thing come to you and put coffee in front of you…!

8. References

1. Weaver, Bill. Scientific Computing & Instrumentation, Vol. 22 Issue 7 Jun. 2005, "Can You Read My Mind?":10-49
2. Siury, Bill. Electronics Now; Vol. 70 Issue 3, Mar. 1999, "A Brain/Computer Interface":55
4. Lay Leng Tan. Innovation; Vol. 4 Issue (2004) "Moving Thoughts":64-65
5. "Researchers Test Brain Implant For Quadriplegics". Electronic Design; Vol. 52 Issue 14, 6/21/2004:8
6. Brooks, Rodney. Technology Review; Vol. 106 Issue 9, Nov. 2003, "Toward a Brain-Internet Link.":30
7. Chase, Victor D.Technology Review; Vol. 103 Issue 2, Mar/Apr. 2000, "Mind Over Muscles":38
8. Yom-Tov, E. Medical & Biological Engineering & Computing; Vol. 41 Issue 1, Jan. 2003, "Detection of movement-related potentials from the electro-encephalogram for possible use in a brain-computer interface." :85