BRAIN COMPUTER INTERFACE

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OVERVIEW

- Definition
- General Principle
- Background
- Components
- Simplified Model of BCI
- Current Brain Computer Interface (BCI) Approaches
- EEG based BCI for tetraplegics
- Brain Controlled Robots
- Braingate BCI
- BCI for healthy users
- Computational challenges and future implementations
Brain Computer Interface from fiction to reality
In the futuristic vision of the Wachowski brothers’ movie trilogy “The Matrix”, humans dive into a virtual world by connecting their brains directly to a computer........
A Brain Computer Interface (BCI) is a collaboration in which a brain accepts and controls a mechanical device as a natural part of its representation of the body.
In healthy subjects, primary motor area sends movement commands to muscles via spinal cord.

In paralyzed people, this pathway is interrupted.

Computer based decoder translates this activity into commands for muscle control.
Signals from an array of neurons read.
Cerebral electric activity recorded.
Signals are amplified.
Transmitted to computer
Transformed to device control commands.
Using computer chips and programs.
Signals translated into action.
How Brain-Computer Interfaces Work

Electrode

Electrode retrieving escaped electric signals

Electrode translates signal

Escaped Electric Signals

Neuron
COMPONENTS

- Signal acquisition
- Preprocessing
- Feature extraction
- Classification
- Application Interface
- Feedback
- Brain signal
- Control signal
SIMPLIFIED MODEL OF THE BCI SYSTEM
CURRENT BCI APPROACHES

BCI APPROACHES

INVASIVE

SEMI INVASIVE

NON INVASIVE
EEG BASED BCI FOR TETRAPLEGICS

- 6-channel EEG BCI used.
- Sensory & motor cortices activated during attempts.
- Control scheme sends movement intention to Prosthetic Controller.
- Prosthetic returns force sensory information to Controller.
- Feedback processed and grip is adjusted.
BRAIN CONTROLLED ROBOTS

- Robot hand mimics subject’s finger movements.
- Signals extracted and decoded by computer program.
- Transferred to hand shaped robot.
- To simulate original movement performed.
- Robot executes commands using onboard sensor readings.
The ‘Braingate’ device can provide motor-impaired patients a mode of communication through the translation of thought into direct computer control.
FEATURES OF BRAINGATE BCI

- Neural Interface Device.
- Consists of signal sensor and external processors.
- Converts neural signals to output signals.
- Sensor consists of tiny chip with electrode sensors.
- Chip implanted on brain surface.
- Cable connects sensor to external signal processor.
- Create communication o/p using decoding software.
ATR HONDA DEVELOP NEW BCI

- BCI for manipulating robots using brain signals.
- Enables decoding natural brain activity.
- MRI based neural decoding.
- No invasive incision of head and brain.
- By tracking haemodynamic responses in brain.
- Accuracy of 85%
BCI FOR HEALTHY USERS

- Induced disability.
- Ease of use in hardware.
- Ease of use in software.
- Otherwise unavailable information.
- Improved training or performance.
- Confidentiality.
- Speed.
- Novelty.
Computational Challenges and Future Implementations

- Minimally invasive surgical methods.
- Next generation Neuro-prosthesis.
- Vision prosthesis.
- BCI for totally paralyzed.
- Minimal number of calibration trials.
- Development of telemetry chip to collect data without external cables.
CONCLUSION

• A potential therapeutic tool.

• BCI System is nominated for the European ICT Grand Prize.

• Potentially high impact technology.
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THANK YOU FOR YOUR ATTENTION