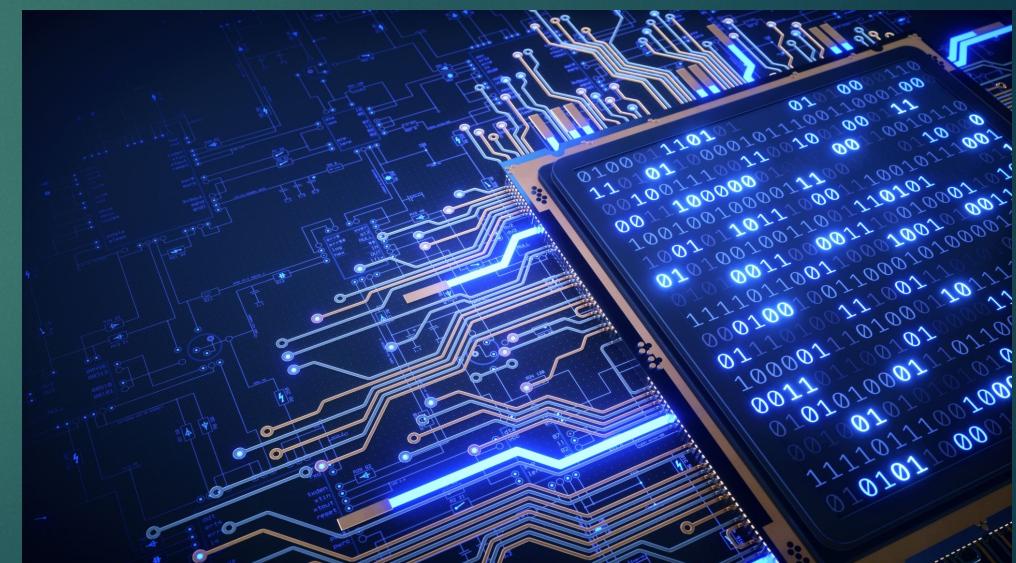
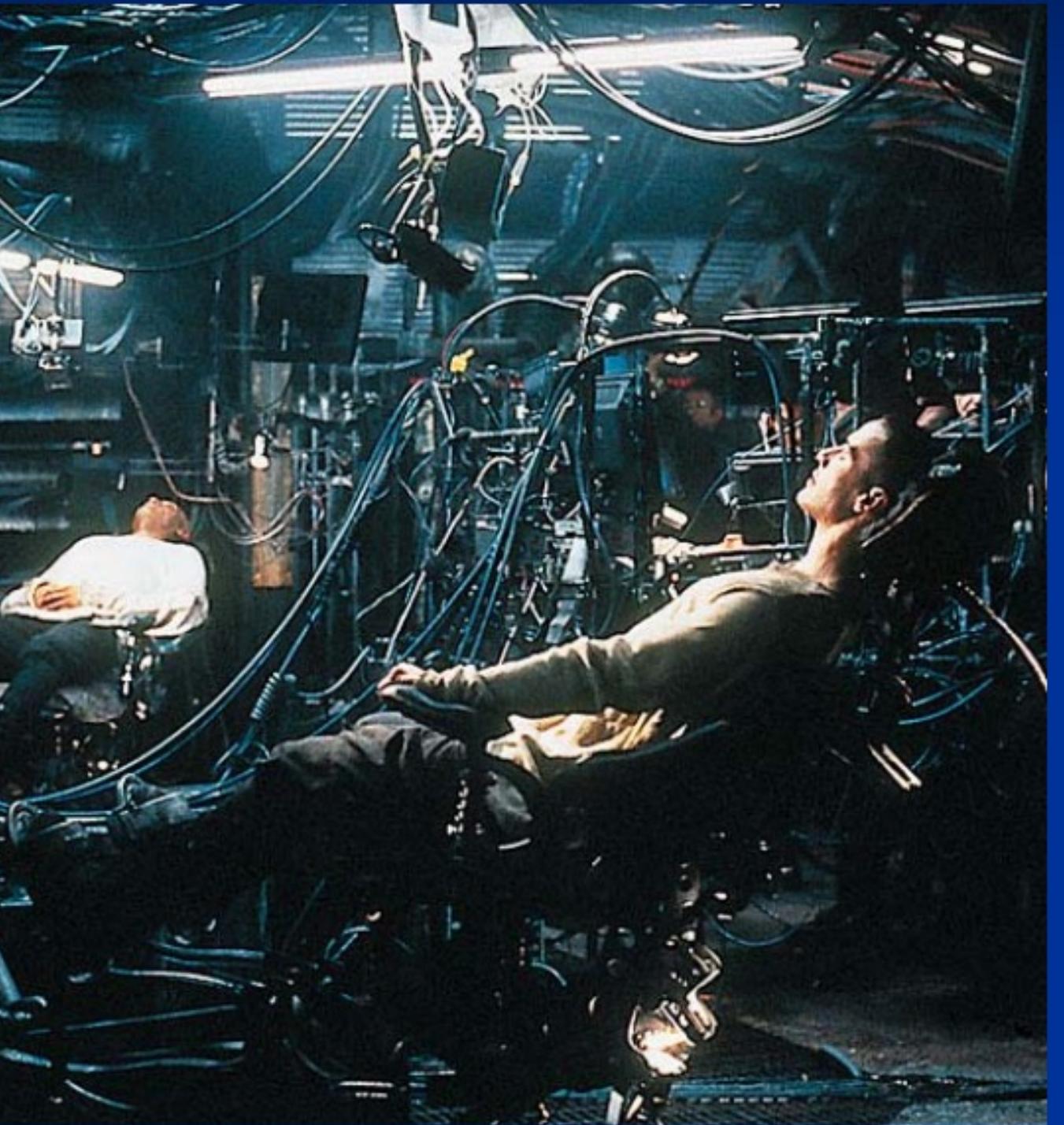
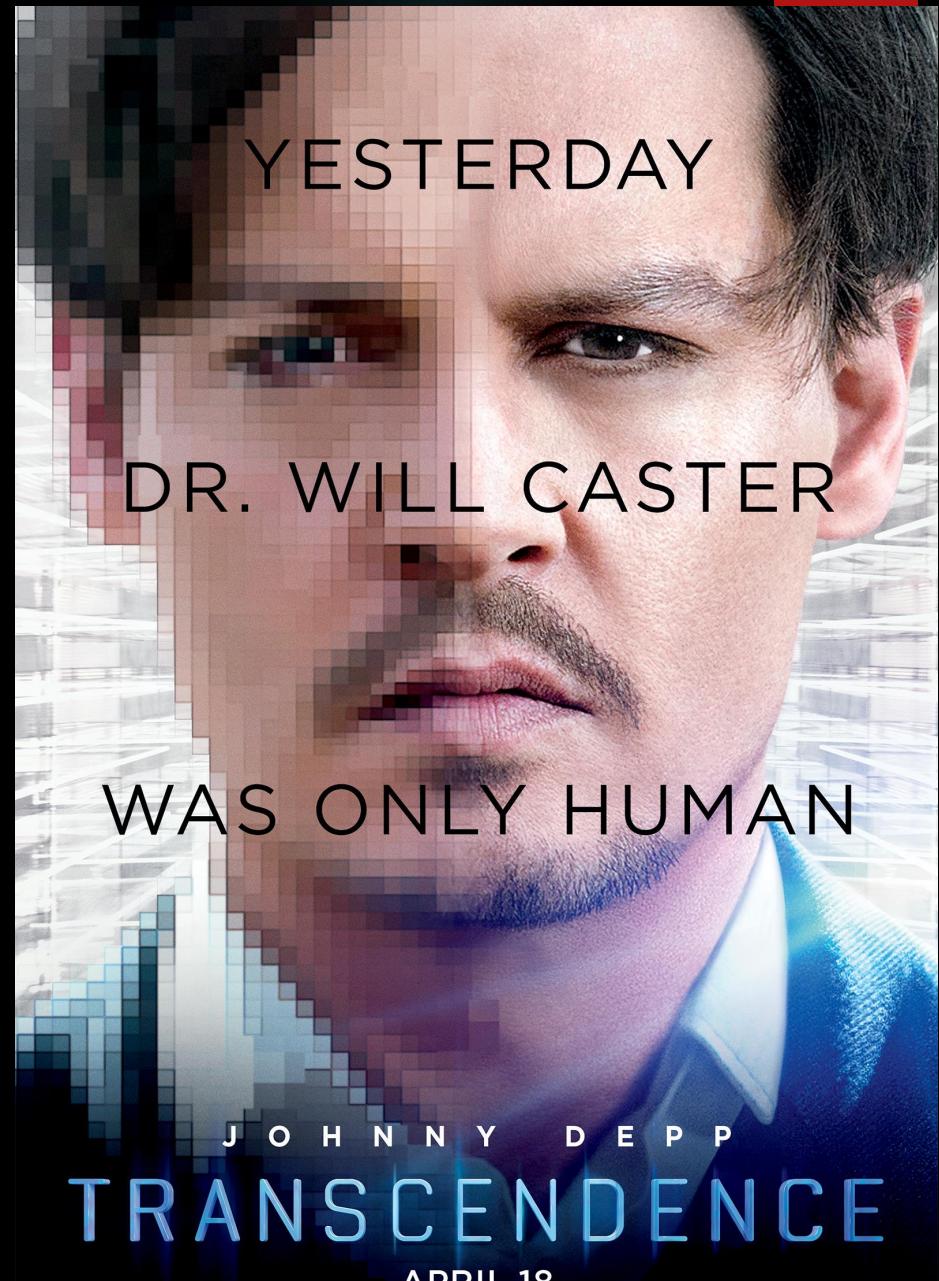


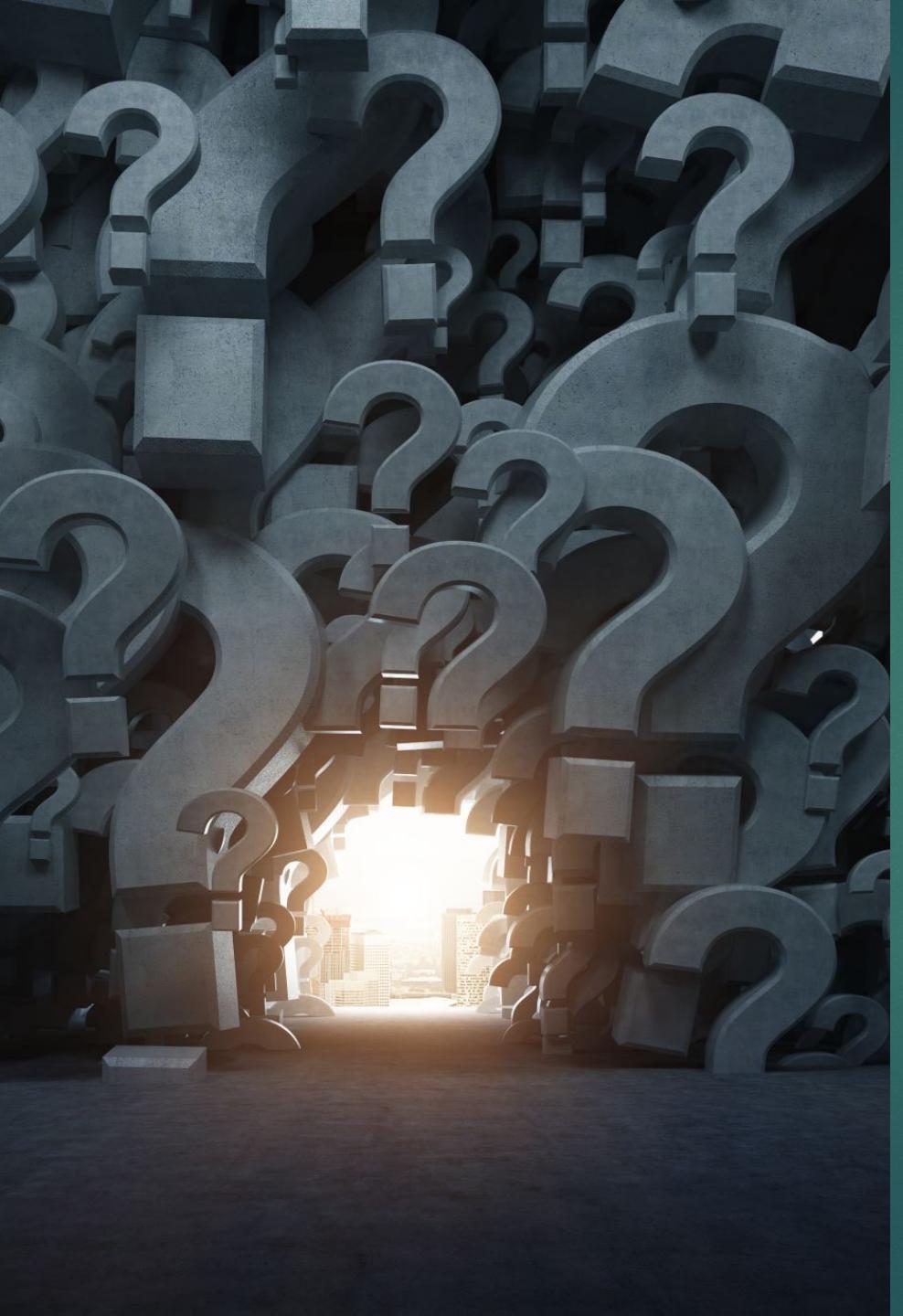
Brain Computer Interaction

- ▶ History of BCI
- ▶ Applications of BCI









Is it FICTION
or is it
POSSIBLE???



Motivation for BCIs

Potential for restoring lost sensory and motor function

To control prosthetic devices such as prosthetic arms or legs for amputees and patients with spinal-cord injuries

Wheelchairs for paralyzed individuals

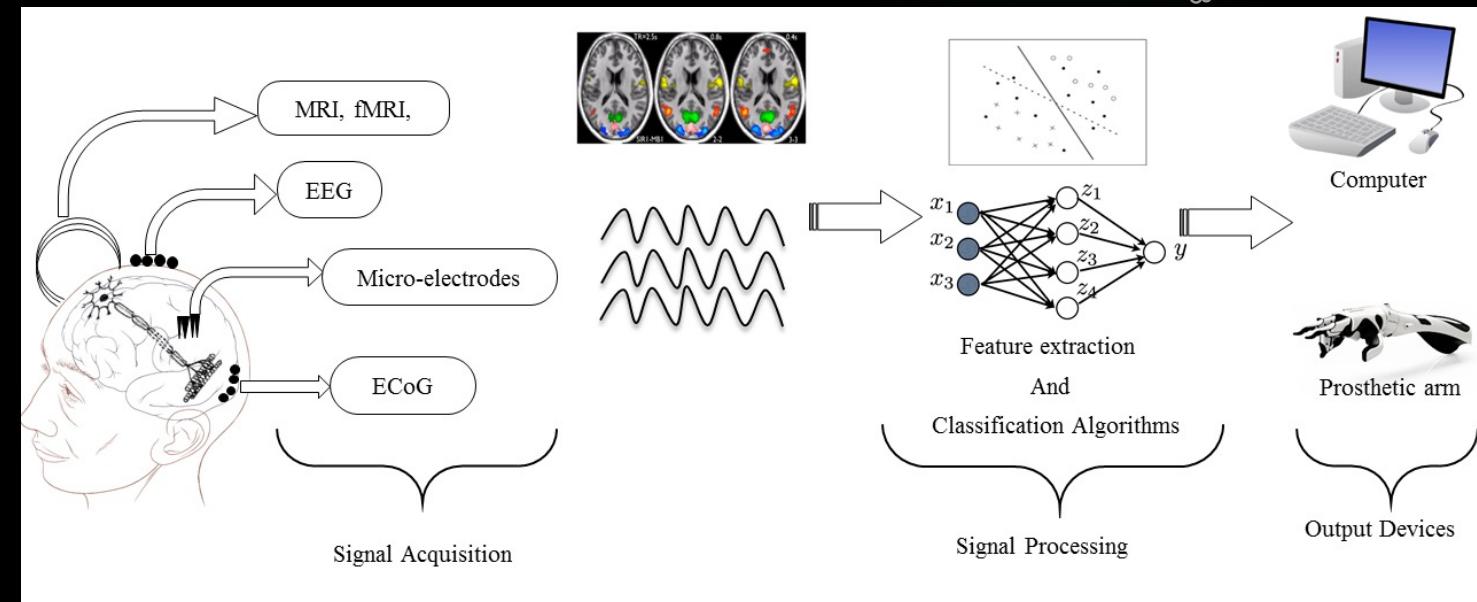
Cursors and word spellers for communication by locked-in patients

Sensory prosthetic devices such as cochlear implant for the deaf, retinal implant for the blind

More recently, researchers have begun exploring BCIs for able-bodied individuals for a host of applications such as Game, Entertainment to robotic avatars, biometric identification and Education.

Brain Computer Interface

- ▶ A system which translates thoughts and provides an interface used for communication called as Brain Computer Interface (BCI)
- ▶ A typical BCI system comprises of signal acquisition system, signal processing (feature extraction and classification) and an output device



Whether BCIs will eventually become as commonplace as current human accessories for sensory and motor augmentation, such as cellular phones and automobiles.????

That remains to be seen.

There are several moral and ethical challenges that society will need to address

History of Brain Computer Interaction



Timeline of BCI

1875

Electrical impulses from a living brain of a rabbit and monkey were recorded for the first time by Richard Caton

1913

Napoleon Cybulski studied the flow of electric current in muscles using his own capacitor.

1965

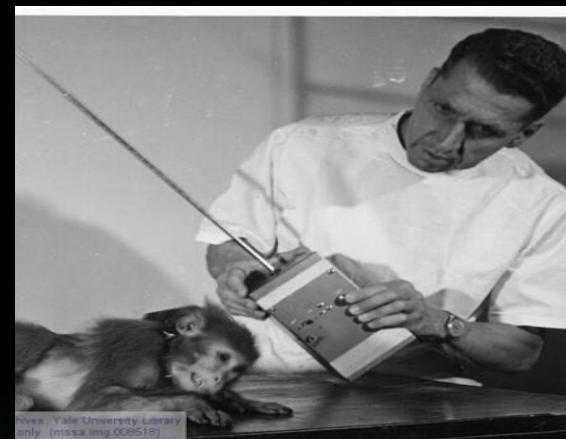
Delgado developed an implantable chip (which he called a “stimoceiver”) that could be used to both stimulate the brain by radio and send electrical signals of brain activity by telemetry, allowing the subject to move about freely.

Adolf Beck studied the brain activity of animals in response to sensory simulation

1890

Hans Berger recorded EEG signals from the lesion area of the human scalp for the first time using a Siemens double-coil galvanometer and non-polarized electrodes.

1920



**1969**

Dr. Eberhard Fetz showed that neural activity could be used to drive an external device.

1990

Philip Kennedy had in 1990 developed “invasive” human brain-computer interface, wires inside the brain attached to a computer.

2004

In 2004, Jonathan Wolpaw and researchers at New York State Department of Health’s Wadsworth Center demonstrated the ability to control a computer using a BCI.

Vidal in 1973 explored the use of scalp-recorded brain signals in humans to implement a simple noninvasive BCI based on “visually evoked potentials”

1973

John Donoghue and his team of Brown University in 2001, commercially design a brain computer interface, the so-called BrainGate.

2001

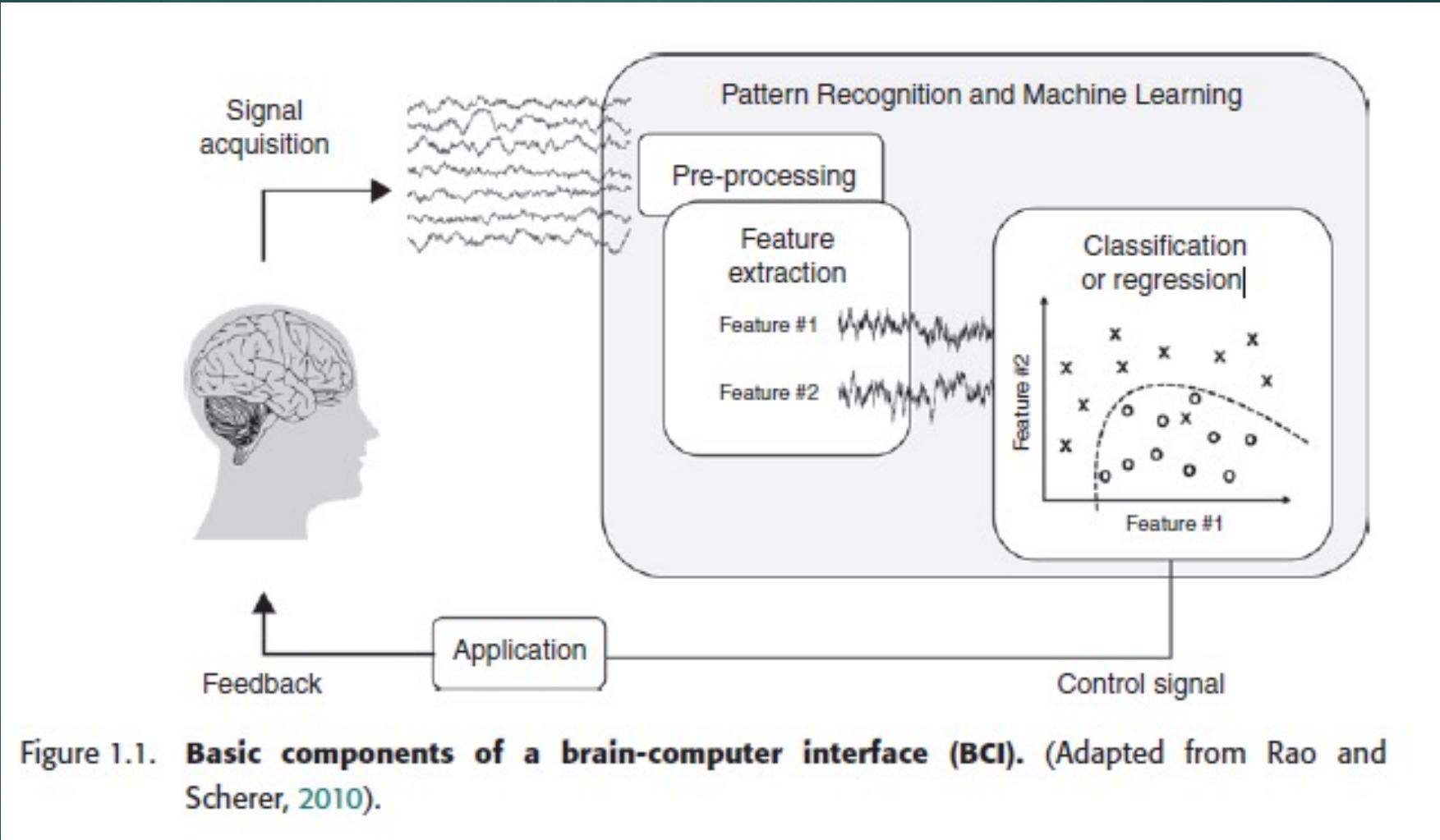
Phil Kennedy implanted electrodes into his brain in order to establish a connection between his motor cortex and a computer

June 2014

To Study the Brain, a Doctor Puts Himself Under the Knife

How one of the inventors of brain-computer interfaces ended up getting one himself.

- ▶ More recently, researchers have begun exploring BCIs for able-bodied individuals for a host of applications such as
 - ▶ Games
 - ▶ Entertainment to robotic avatars, biometric identification,
 - ▶ and Education.



BCI Applications

Hype Cycle for Emerging Technologies, 2020



BCI Applications

- ▶ Device Control
- ▶ User State Monitoring
- ▶ Training and Education
- ▶ Games and Entertainment.
- ▶ Cognitive improvement
- ▶ Safety and Security

Medical Applications

prevention

- smoking
- alcoholism
- motion sickness

detection and diagnosis

- tumors
- brain disorders
- sleep disorders

rehabilitation and restoration

- brain stroke
- disability
- psychological disorders

Device controls

- ▶ For rehabilitation
 - ▶ Prosthetic arm
 - ▶ Prosthetic legs

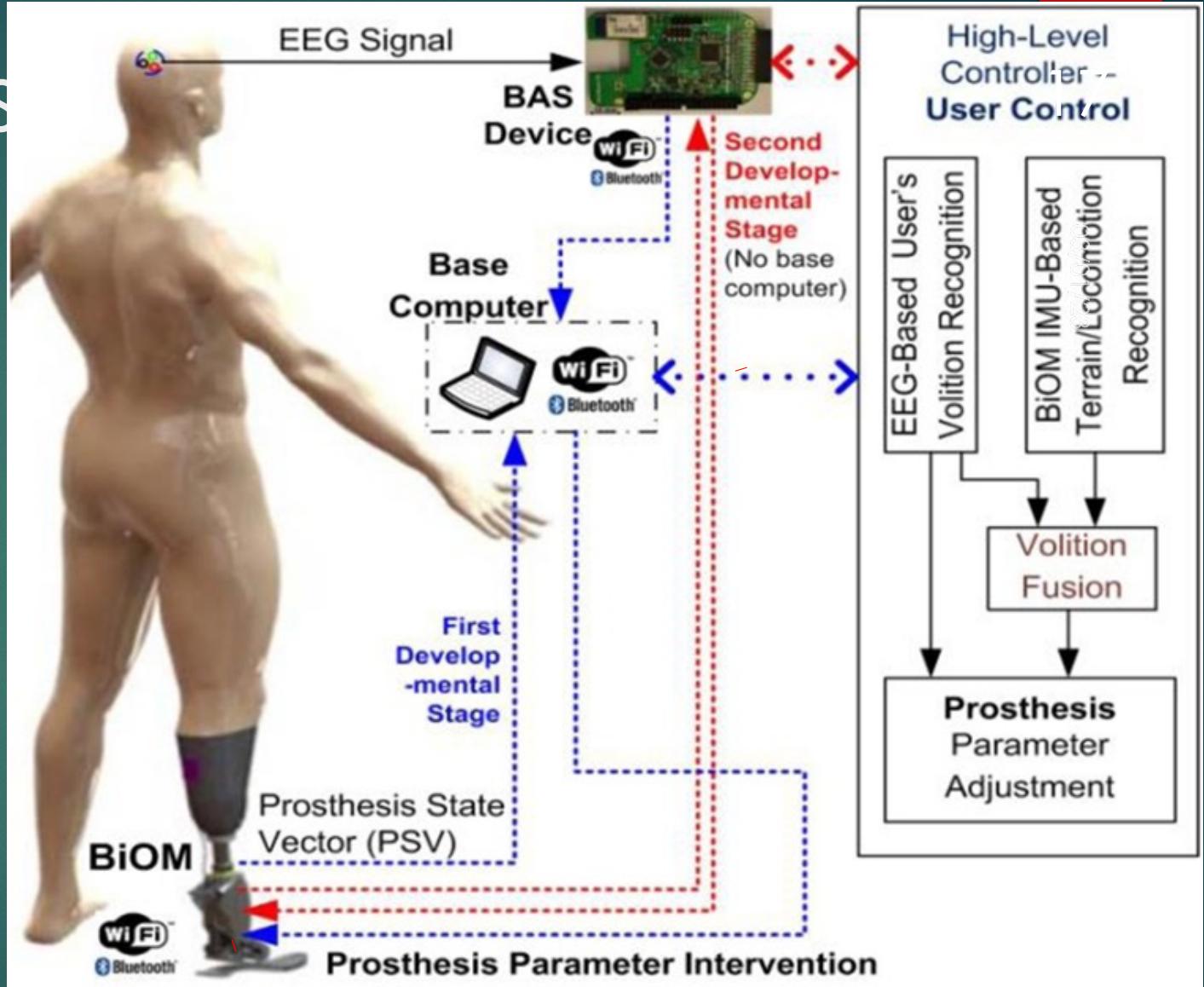
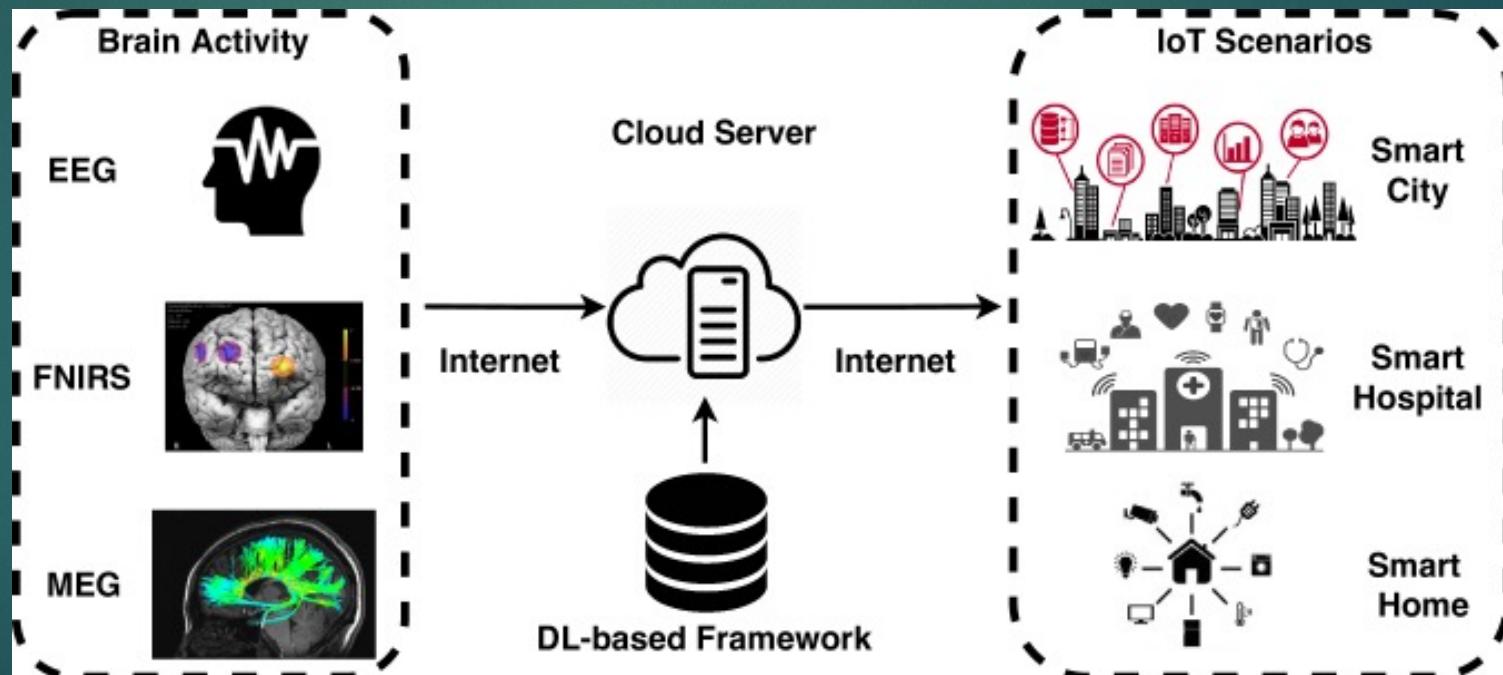


Image credits:

https://www.frontiersin.org/files/Articles/308916/fneur-08-00696-HTML/image_m/fneur-08-00696-g001.jpg

Neuroergonomics and smart environment

- ▶ Cooperation between Internet of Things (IOT) and BCI technologies
- ▶ intelligent transportation



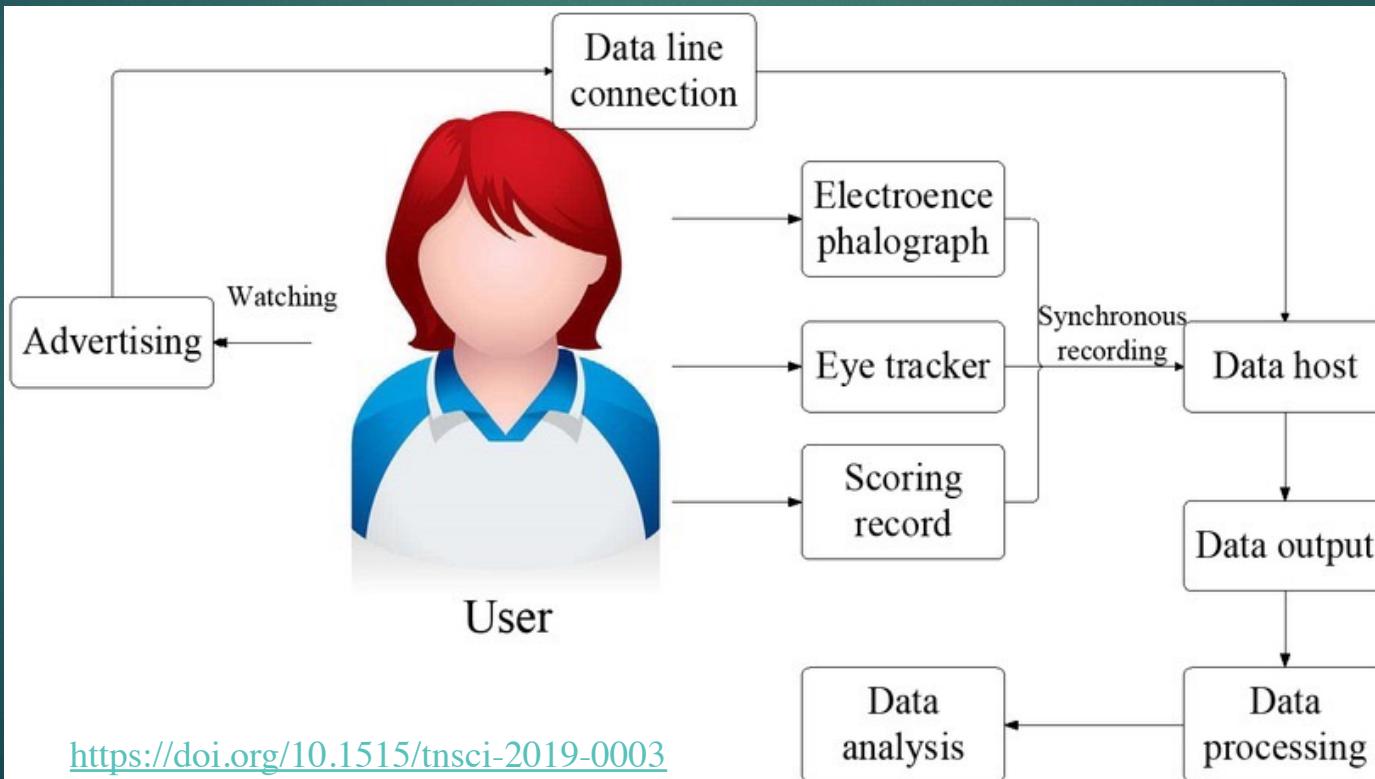
by [Xiang Zhang, et al.](#) .

Neuromarketing and advertisement

19

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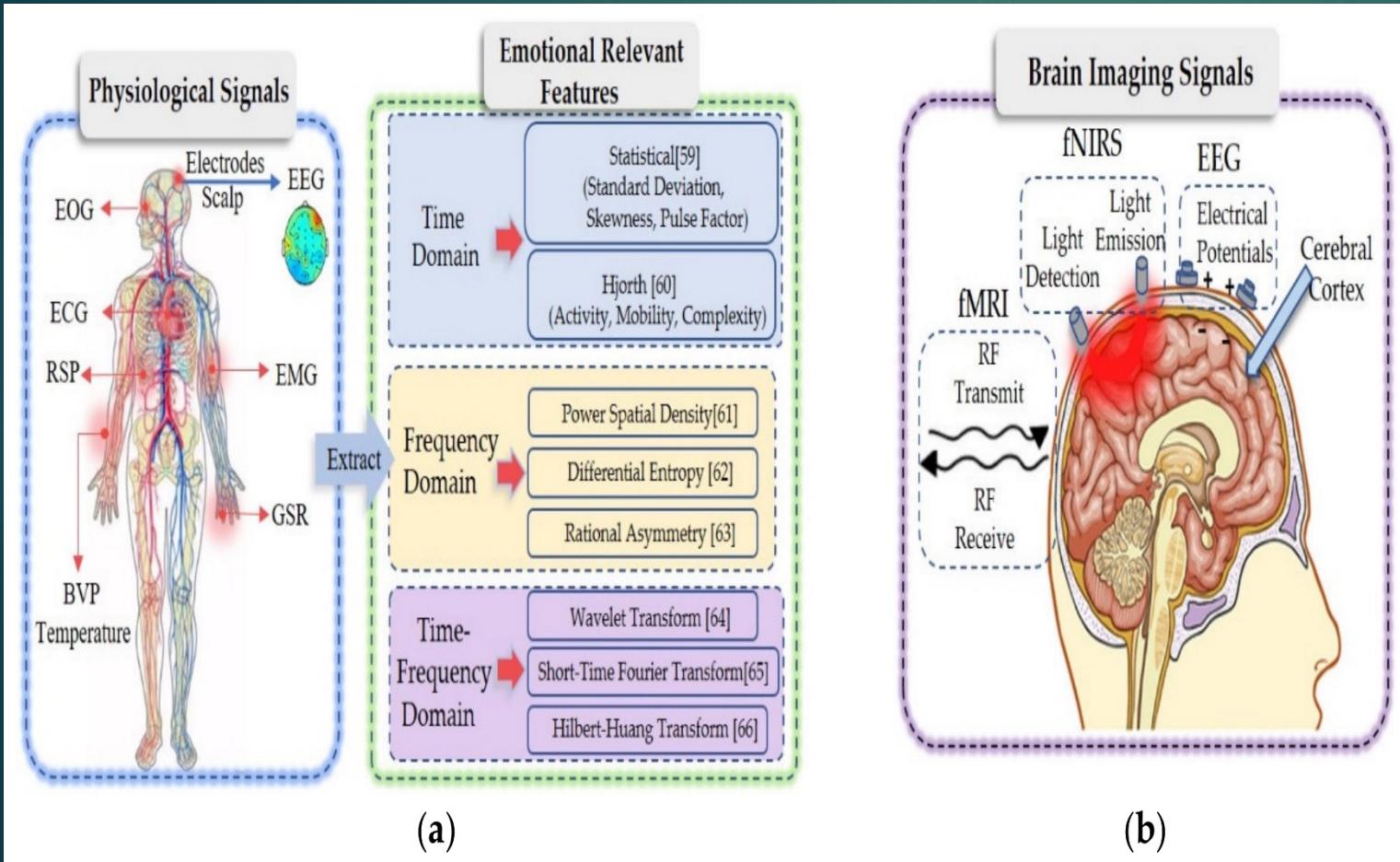
- ▶ EEG evaluation for TV advertisements related to both commercial and political fields.
 - ▶ The generated attention accompanying watching activity
 - ▶ Estimating the memorization of TV advertisements



Educational and self-regulation

- ▶ Emotional regulation

- ▶ Use of fMRI–EEG BCI to fight the depression feeling as well as other neuropsychiatric disorders



Advances in Multimodal Emotion Recognition Based on Brain–Computer Interfaces
by Zhipeng He

Challenges

- ▶ Usability
- ▶ Hardware
- ▶ Signal processing
- ▶ System integration
- ▶ Cost