
A Seminar
on
BRAIN COMPUTER INTERFACES
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SITAMS

- BCI Model
- Early Work
- Applications
- BCI Approaches
- Current Projects

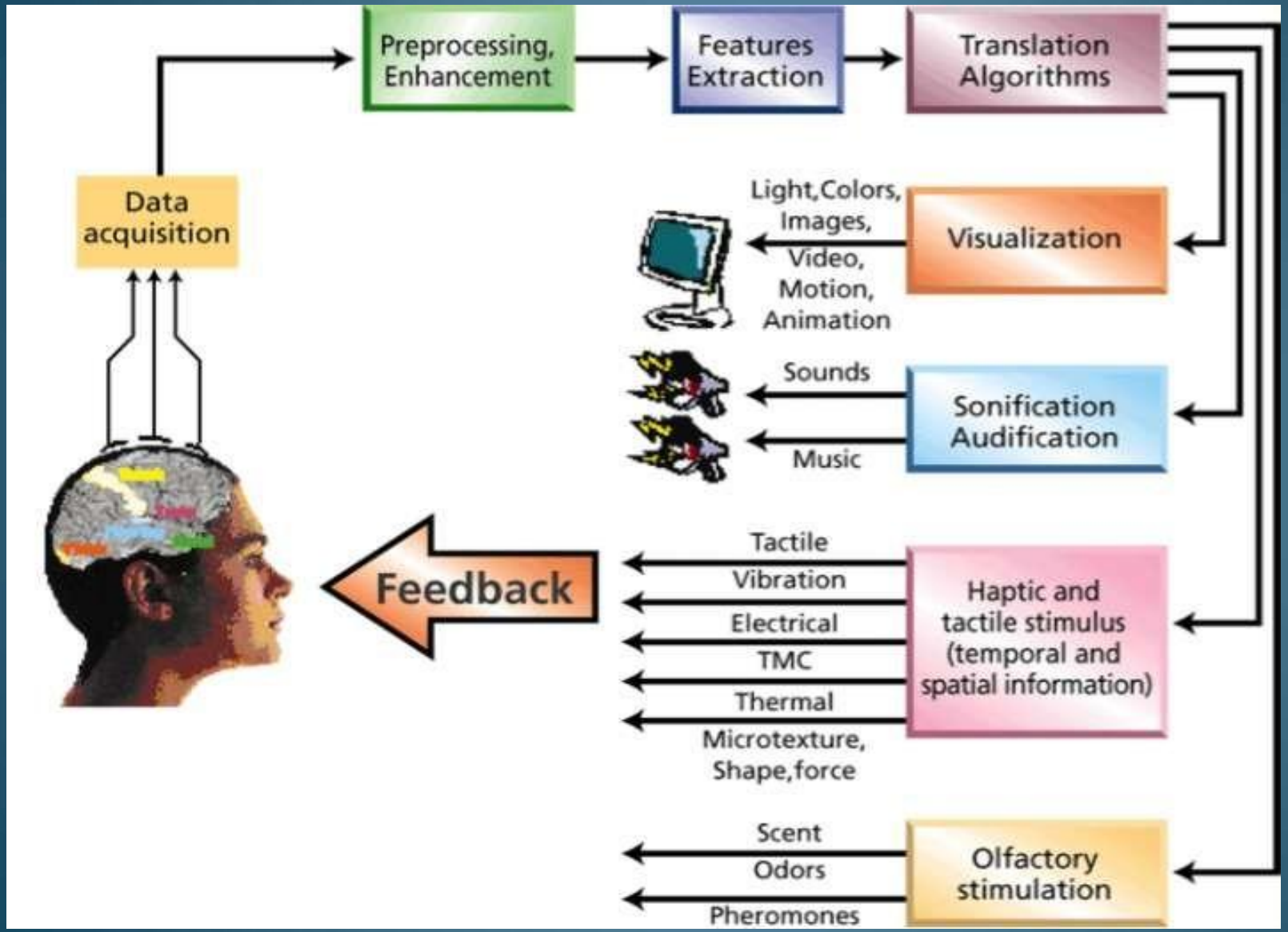
INDEX

- Brain-computer interface (BCI) is a fast-growing emergent technology, in which researchers aim to build a direct channel between the human brain and the computer.

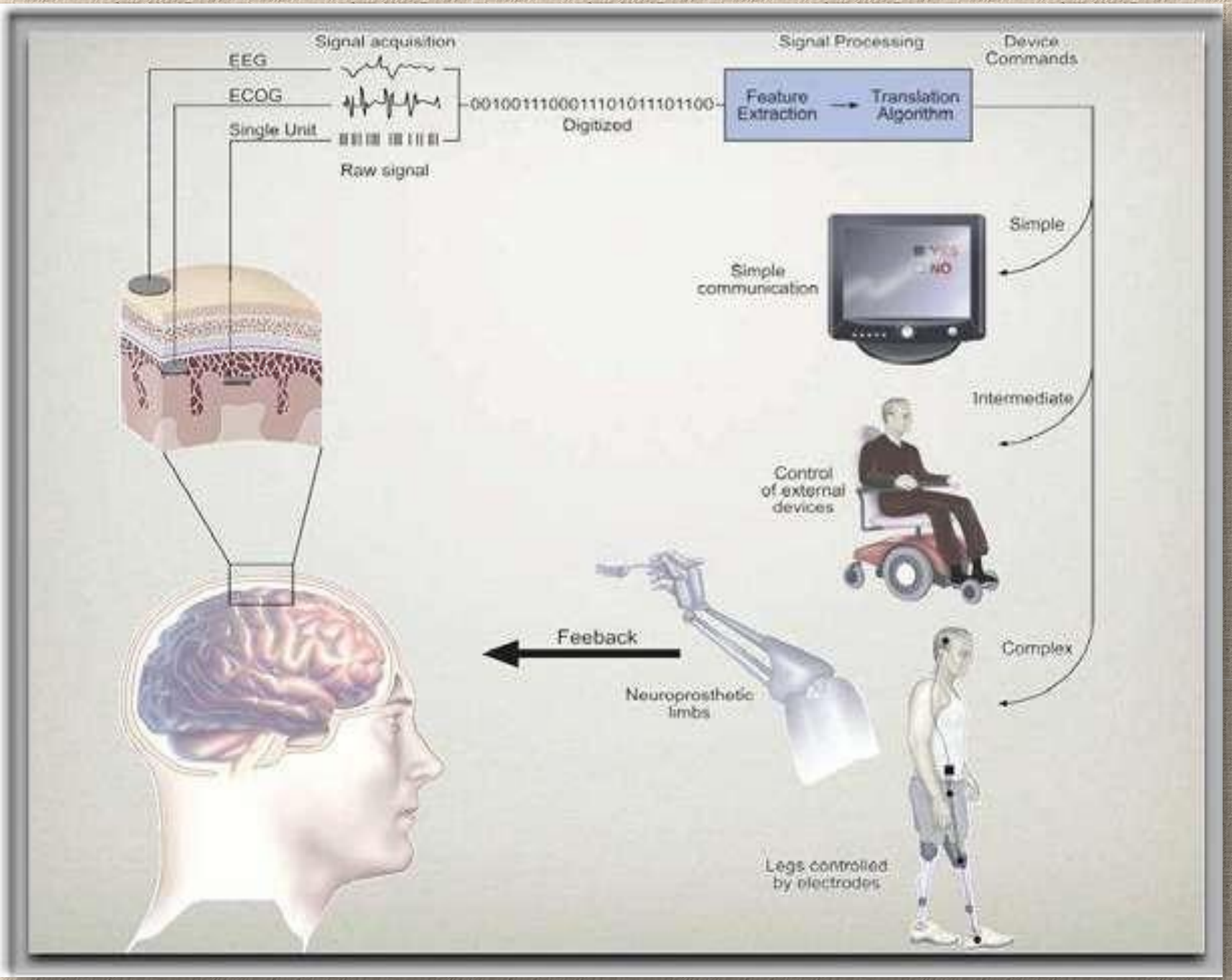
- A Brain Computer Interface (BCI) is a collaboration in which a brain accepts and controls a mechanical device as a natural part of its representation of the body.

- Computer-brain interfaces are designed to restore sensory function, transmit sensory information to the brain, or stimulate the brain through artificially generated electrical signals

B C I


Preprocessing, Enhancement
Features Extraction
Translation Algorithms
Data acquisition
Light,Colors, Images, Video, Motion, Animation
Visualization
Sounds
Music
Sonification Audification
Feedback
Tactile
Vibration
Electrical
TMC
Thermal
Microtexture, Shape,force
Haptic and tactile stimulus (temporal and spatial information)
Scent
Odors
Pheromones
Olfactory stimulation

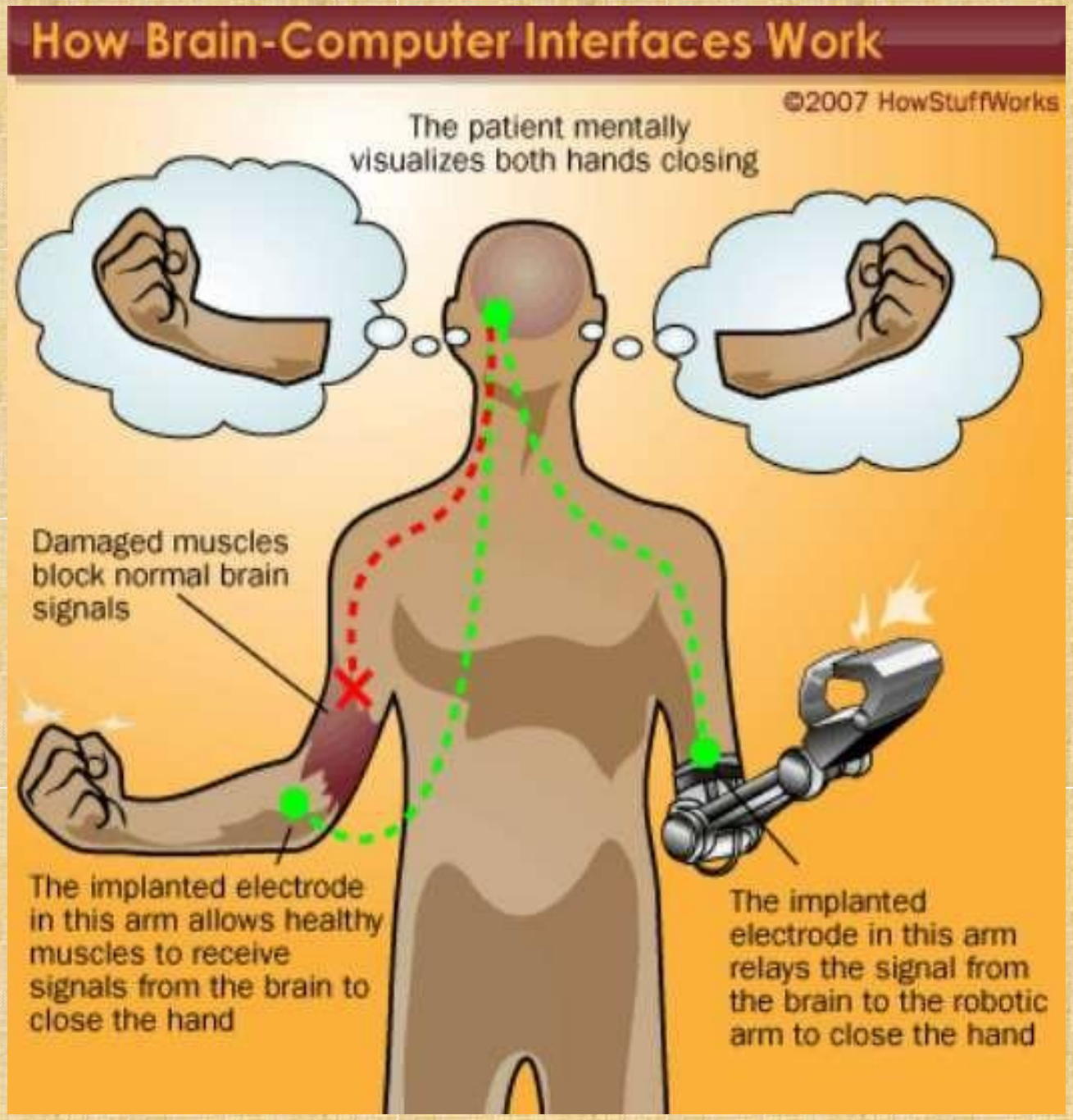
BCI MODEL


Signal acquisition
EEG
ECOG
Single Unit
Raw signal
0010011100011101011101100
Digitized
Signal Processing
Feature Extraction
Translation Algorithm
Device Commands
Simple
Simple communication
Intermediate
Control of external devices
Complex
Feeback
Neuroprosthetic limbs
Legs controlled by electrodes

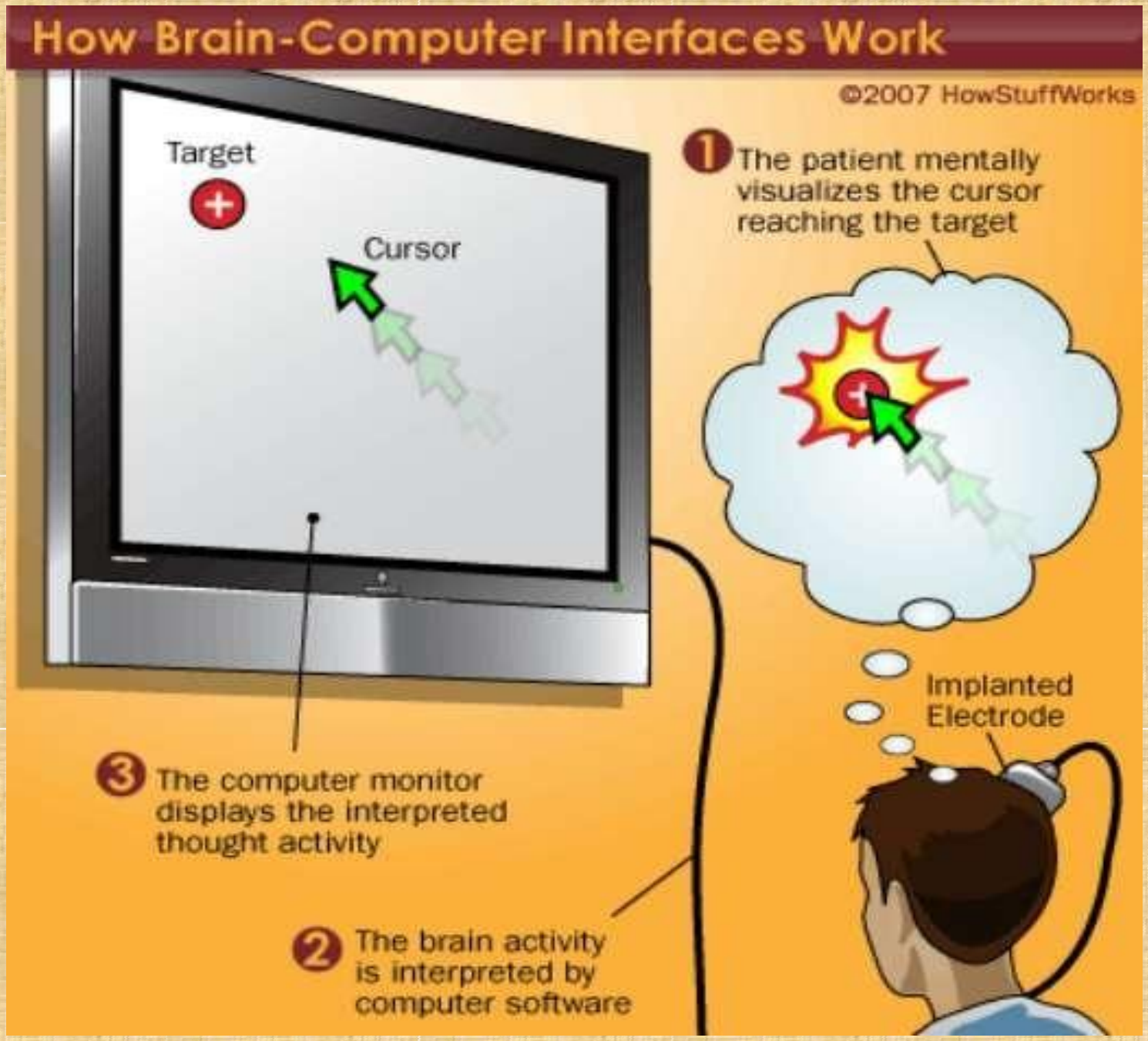
BCI MODEL

EARLY WORK

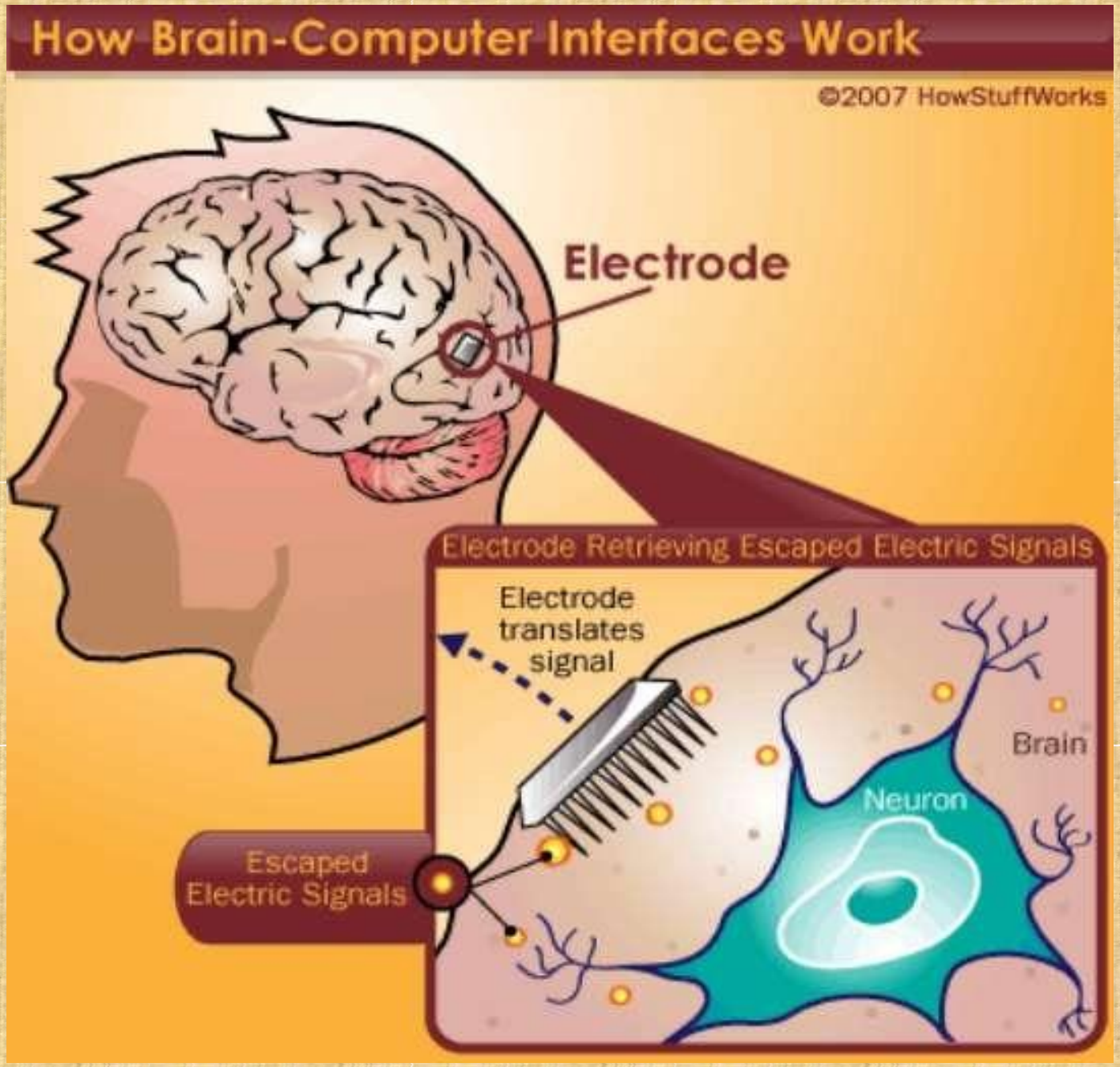
- Algorithms to reconstruct movements from motor cortex neurons, which control movement, were developed in 1970s.
- The first Intra-Cortical Brain-Computer Interface was built by implanting electrodes into monkeys.
- After conducting initial studies in rats during the 1990s, researchers developed Brain Computer Interfaces that decoded brain activity in monkeys and used the devices to reproduce movements in monkeys and used the devices to reproduce monkey movements in robotic arms.



HOW BCI WORKS

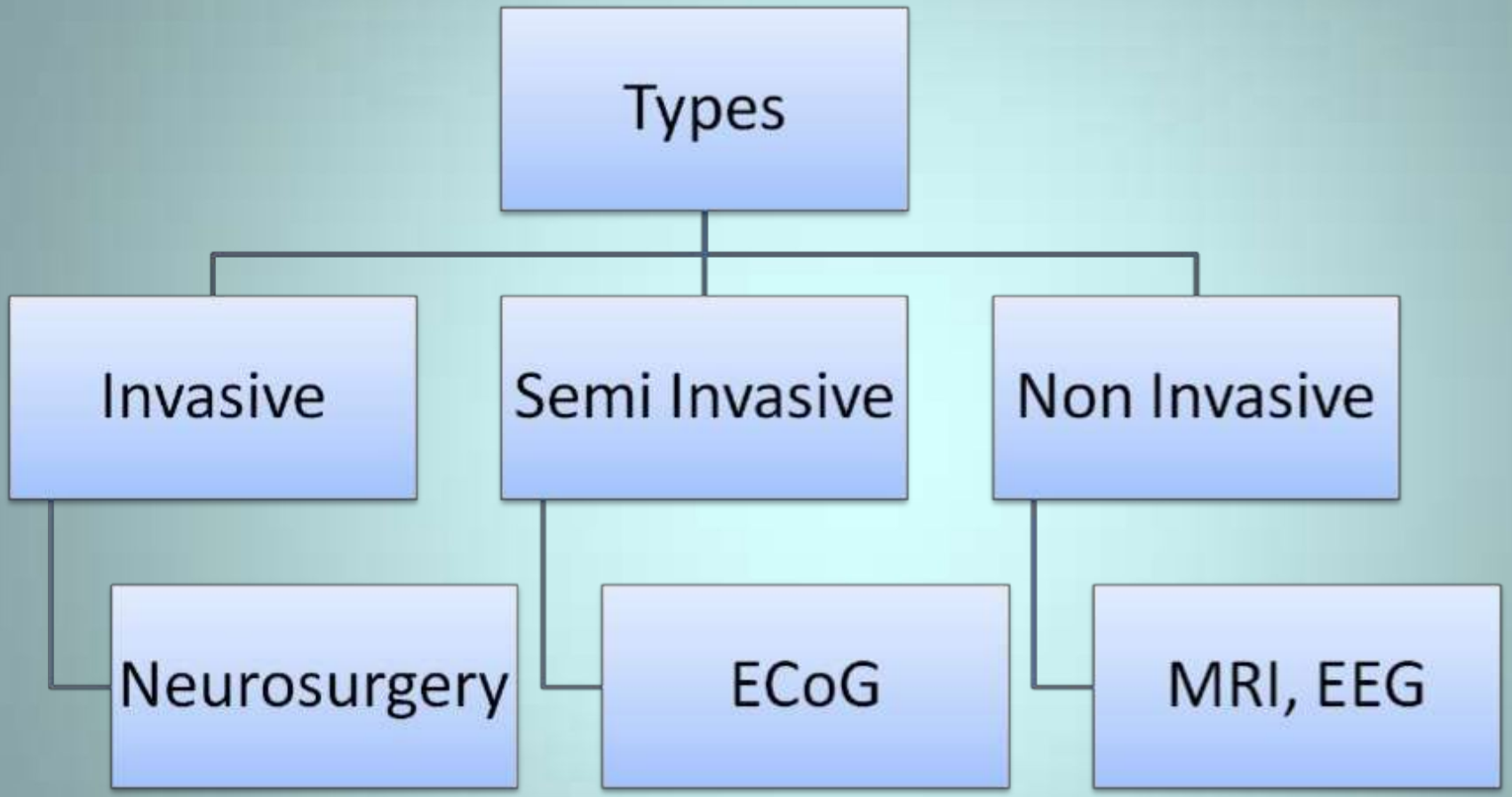


H O W B C I W O R K S



HOW BCI WORKS

BCI APPROACHES



INVASIVE

- Invasive BCIs are implanted directly into the grey matter of the brain during neurosurgery.
- As they rest in the grey matter, invasive devices produce the highest quality signals of BCI devices but are prone to scar- tissue build- up, causing the signal to become weaker or even lost as the body reacts to a foreign object in the brain.

TYPES

SEMI AND NON INVASIVE

- ***Electrocorticography*** **(ECoG)** measures the electrical activity of the brain taken from beneath the skull in a similar way to non-invasive electroencephalography but the electrodes are embedded in a thin plastic pad that is placed above the cortex, beneath the Dura mater.

- ***Electroencephalography*** In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp with a conductive gel or paste, usually after preparing the scalp area by light abrasion to reduce impedance due to dead skin cells. Many systems typically use electrodes, each of which is attached to an individual wire.

TYPES

SEMI AND NON INVASIVE

- ***fMRI = Functional Magnetic Resonance Imaging*** fMRI exploits the changes in the magnetic properties of hemoglobin as it carries oxygen. Activation of a part of the brain increases oxygen levels there increasing the ratio of ox hemoglobin to deoxyhemoglobin.

- ***Magnetoencephalography (MEG)*** MEG detects the tiny magnetic fields created as individual neurons "fire" within the brain. It can pinpoint the active region with a millimeter, and can follow the movement of brain activity as it travels from region to region within the brain.

TYPES

APPLICATIONS

- Provide disabled people with communication, environment control, and movement restoration.
- Provide enhanced control of devices such as wheel chairs, vehicles, or assistance robots for people with disabilities.
- Provide additional channel of control in computer games.
- Monitor attention in long-distance drivers or aircraft pilots, send out alert and warning for aircraft pilots.
- Develop intelligent relaxation devices.

APPLICATIONS

- Control robots that function in dangerous or inhospitable situations (e.g., underwater or in extreme heat or cold).
- Create a feedback loop to enhance the benefits of certain therapeutic methods.
- Develop passive devices for monitoring function, such as monitoring long-term drug effects, evaluating psychological state, etc.
- Monitor stages of sleep

APPLICATIONS

- Bionics/Cybernetics
- Memory Upload/Download
- Dream Capture
- Brain as a Computer
- “Google Search” through brain

- BrainGate
- BCI2000
- Bionic Eye
- Honda Asimo Control
- Kevin Warwick – The First Human Cyborg
- Gaming Control
- Many Others….

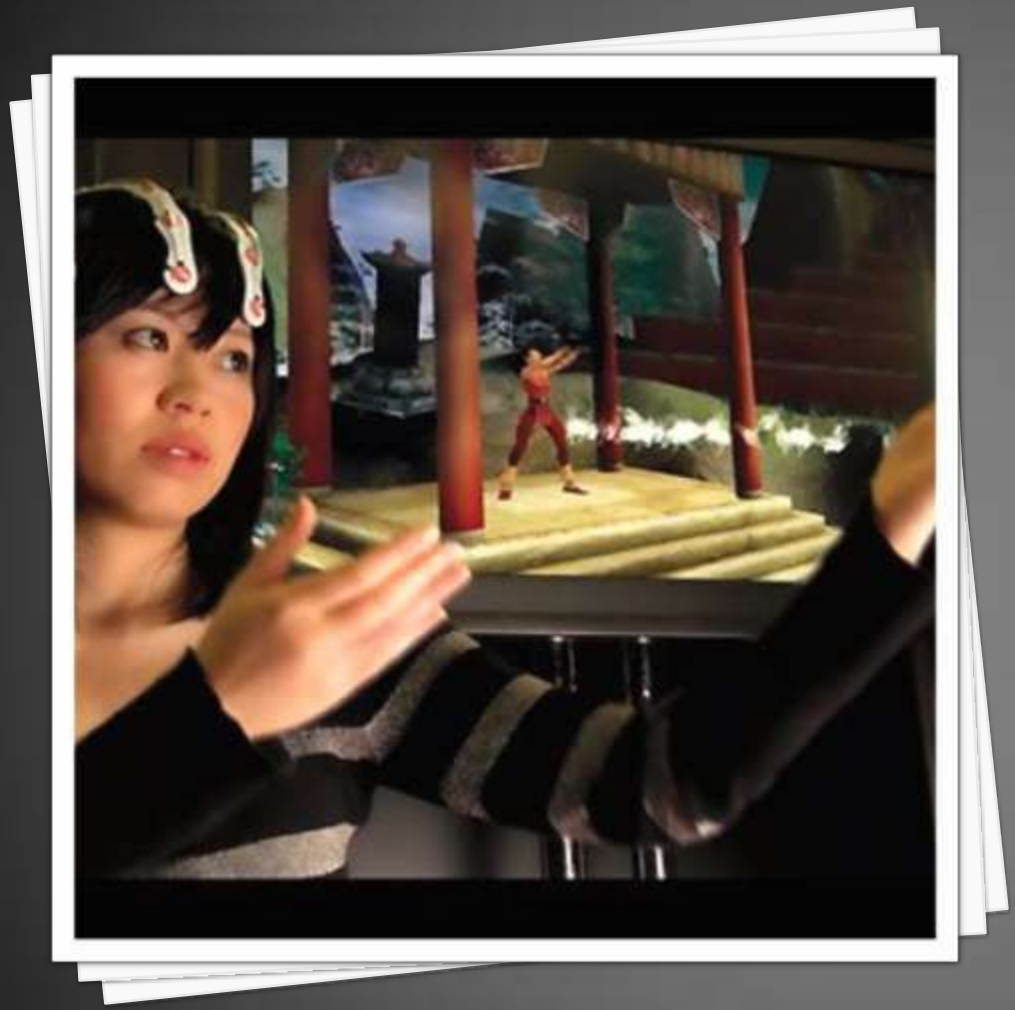
PROJECTS

BRAIN GATE

The sensor, which is implanted into the brain, monitors brain activity in the patient and converts the intention of the user into computer commands.

HONDA ASIMO CONTROL

Researchers have developed an interface for Honda's Asimo robot that allows individuals to control it simply by thinking.

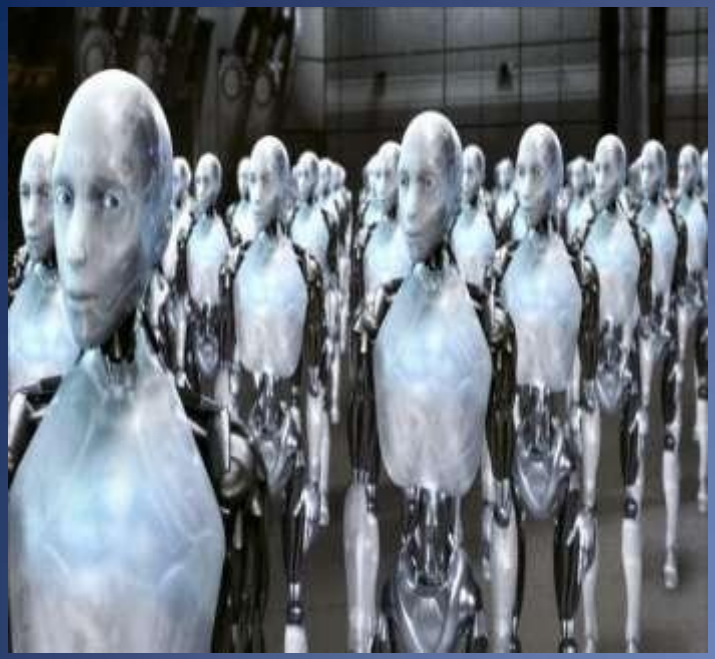


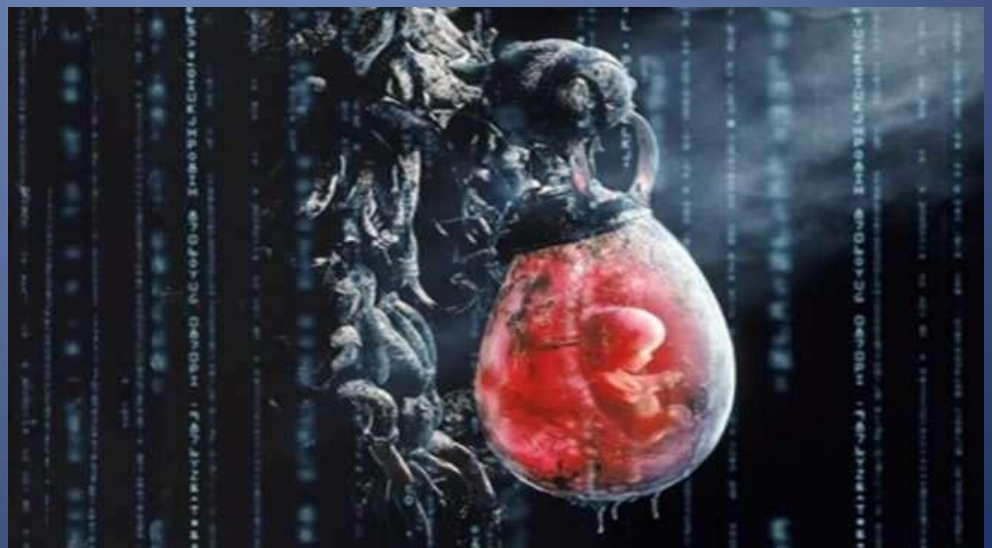
GAMING CONTROL

Gaming control using a wearable and wireless EEG-based brain-computer interface device with novel dry foam-based sensors.

BIONIC EYE

A **visual prosthesis**, often referred to as a **bionic eye**, is an experimental visual device intended to restore functional vision in those suffering from partial or total blindness





FUTURE ..?

ADVANTAGES OF BCI

- Allow paralyzed people to control prosthetic limbs with their mind
- Transmit visual images to the mind of a blind person, allowing them to see
- Transmit auditory data to the mind of a deaf person, allowing them to hear
- Allow gamers to control video games with their minds
- Allow a mute person to have their thoughts displayed and spoken by a computer

DISADVANTAGES OF BCI

- Research is still in beginning stages
- The current technology is crude
- Ethical issues may prevent its development
- Electrodes outside of the skull can detect very few electric signals from the brain
- Electrodes placed inside the skull create scar tissue in the brain

CONCLUSION

- A potential therapeutic tool.
- BCI is an advancing technology promising paradigm shift in areas like Machine Control, Human Enhancement, Virtual reality and etc. So, it's potentially high impact technology.
- Several potential applications of BCI hold promise for rehabilitation and improving performance, such as treating emotional disorders (for example, depression or anxiety), easing chronic pain, and overcoming movement disabilities due to stroke.
- Will enable us to achieve singularity very soon.
- Intense R&D in future to attain intuitive efficiency.

THANK YOU..