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**Brain Computer Interface (BCI)**

Steps -

1. Signal acquisition : EEG recorded through electrodes placed on scalp
2. Signal processing : Noise reduction, feature extraction, pattern recognition
3. Translation : Translation of signals into machine commands
4. Control of external devices : Ex – Toy car, cursor, etc.

Types -

1. Invasive : Electrodes implanted directly into brain
2. Non-invasive : Use of EEG devices (scalp placement)
3. Semi-invasive : Electrodes placed on surface of brain but under the skull

Brain activity -> Signal Acquisition(EEG)->Signal processing->Feature Extraction->ML model->Command->Device control

**EEG(Electroencephalography)**

* It is a method used to record electrical activity of the brain through electrodes placed on the scalp
* Electrical signals reflect brain activity and can be processed to infer mental states.
* It records different types of brain waves corresponding to various mental states.
* 1. Delta waves(0.5-4Hz):Associated with deep sleep
* 2. Theta waves(4-8Hz):Related to light sleep and relaxation
* 3. Alpha waves(8-13Hz):Linked to relaxation and calm focus
* 4. Beta waves(13-30Hz):Associated with active thinking, problem-solving, and focus.
* 5. Gamma waves(30-100Hz):Linked to higher mental activity and consciousness.

**EEG channels**

* EEG signals are collected from various positions on the scalp using a system called the 10-20 system, which specifies where electrodes should be placed for optimal data collection. (eg. (Frontal)F3, (Central)C3, (Occipital)O1).
* Artifacts : EEG signals are prone to noise from other bodily movements, like blinking, muscle activity, which need to be filtered out during processing.

**EEG recording**

* Sampling rate (in Hz)
* Typical EEG device (250Hz) i.e. 250 data points/sec

**Signal processing**

* Filtering : Remove noise.
* Feature extraction : Identify key components
* Classification : Use ML algorithms to classify these signals into meaningful o/ps.

**References -**

* **ChatGPT**