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Generation Of Brain Waves In Different Psychological Conditions

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ABSTRACT

This paper depicts the study of generation of Brain Waves using E.E.G. and its application to identify a person, by analysis of his psychological characteristics for a certain condition. It is basically the combination of neurology, psychology and technology. Here, we will deal with the psychological aspects of the brain. E.E.G. deals with the acquisition of brain waves, in the form of electric potentials, which accumulates on the scalp, as a result of various electrochemical processes in the brain, due to neurons, the message carrier. These neurons are responsible for the communication between the brain and the body, through electrical signals, which carries a message, either from brain to body or vice versa. The brain waves, thus evolved have certain frequencies, on the basis of which they are divided into five categories, as, Delta (0.5Hz – 4 Hz), Theta (4 – 7 Hz), Alpha (8 – 13 Hz), Beta (13 – 30 Hz) and Gamma (35 Hz and up). They show various psychological and mental conditions of the person, for different conditions. These analog signals are then further digitized and interfaced with the PC, and their waveform can be displayed, processed (artifact rejection) and recorded using the MATLAB software.

Keywords : *E.E.G. , scalp, E.M.G., ECoG, Artifacts, Neocortex , M.E.G., E.O.G.*

1. INTRODUCTION

A brain-machine interface is an interface in which a brain accepts and controls a mechanical device as a natural part of its body. The purpose of the brain-machine interface is to provide a method for people with damaged sensory and motor functions to use their brain to control artificial devices and restore lost ability via the devices. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp. In neurology, the main diagnostic application of EEG is in the case of epilepsy, as epileptic activity can create clear abnormalities on a standard EEG study. A secondary clinical use of EEG is in the diagnosis of coma, encephalopathy, and brain death.

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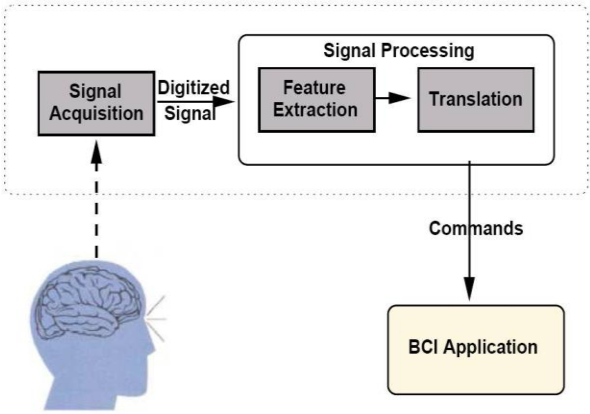

Figure1: Block Diagram of B.M.I.

2. SOURCE OF E.E.G. ACTIVITY

The electrical activity of the brain can be described in spatial scales from the currents within a single dendritic spine to the relatively gross potentials that the EEG records from the scalp, much the same way that economics can be studied from the level of a single individual's personal finances to the macro-economics of nations. Neurons, or nerve cells, are electrically active cells that are primarily responsible for carrying out the brain's functions. This neurotransmitter then activates a receptor in the dendrite or body of the neuron that is on the other side of the synapse, the post-synaptic neuron.

3. ACQUISITION AND CONDITIONING OF E.E.G. SIGNALS

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. Some systems use caps or nets into which electrodes are embedded; this is particularly common when high-density arrays of electrodes are needed. Each electrode is connected to one input of a differential amplifier (one amplifier per pair of electrodes); a common system reference electrode is connected to the other input of each differential amplifier. These amplifiers amplify the voltage between the active electrode and the reference (typically 1,000–100,000 times, or 60–100 dB of voltage gain). In analog EEG, the signal is then filtered, and the EEG signal is output as the deflection of pens as paper passes underneath.

4. PROCESSING OF E.E.G. SIGNALS

During the recording, a series of activation procedures may be used. These procedures may induce normal or abnormal EEG activity that might not otherwise be seen. The digital EEG signal is stored electronically and can be filtered for display. Typical settings for the high-pass filter and a low-pass filter are 0.5-1 Hz and 35–70 Hz, respectively. A typical adult human EEG signal is about 10μV to 100 μV in amplitude when measured from the scalp. and is about 10–20 mV when measured from subdural electrodes. Since an EEG voltage signal represents a difference between the voltages at two electrodes, the display of the EEG for the reading encephalograph may be set up in one of several ways. The representation of the EEG channels is referred to as a montage.

5. BRAIN WAVES – CLASSIFICATION

The EEG is typically described in terms of (1) rhythmic activity and (2) transients. The rhythmic activity is divided into bands by frequency. To some degree, these frequency bands are a matter of nomenclature (i.e., any rhythmic activity between 8–12 Hz can be described as "alpha"), but these

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designations arose because rhythmic activity within a certain frequency range was noted to have a certain distribution over the scalp or a certain biological significance.

Delta is the frequency range up to 4 Hz. It tends to be the highest in amplitude and the slowest waves. It is seen normally in adults in slow wave sleep. It is also seen normally in babies. It may occur focally with subcortical lesions and in general distribution with diffuse lesions, metabolic encephalopathy hydrocephalus or deep midline lesions.

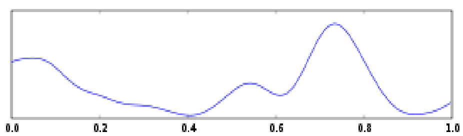

Figure2: Delta waves

Theta is the frequency range from 4 Hz to 7 Hz. Theta is seen normally in young children. It may be seen in drowsiness or arousal in older children and adults; it can also be seen in meditation. Excess theta for age represents abnormal activity.

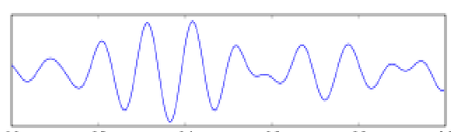

Figure3: Theta waves

Alpha is the frequency range from 8 Hz to 12 Hz. Hans Berger named the first rhythmic EEG activity he saw, the "alpha wave. This was the "posterior basic rhythm" (also called the "posterior dominant rhythm" or the "posterior alpha rhythm"), seen in the posterior regions of the head on both sides, higher in amplitude on the dominant side.

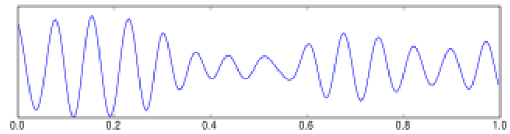

Figure4: Alpha waves

Beta is the frequency range from 12 Hz to about 30 Hz. It is seen usually on both sides in symmetrical distribution and is most evident frontally. Beta activity is closely linked to motor behavior and is generally attenuated during active movements.

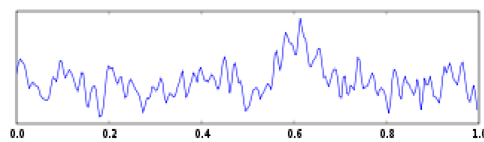

Figure5: Beta waves

Gamma is the frequency range approximately 30–100 Hz. Gamma rhythms are thought to represent binding of different populations of neurons together into a network for the purpose of carrying out a certain cognitive or motor function.

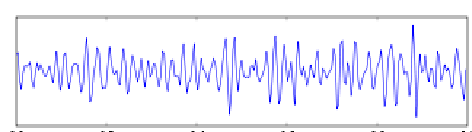

Figure6: Gamma waves

Electrical signals detected along the scalp by an EEG, but that originate from non-cerebral origin are called artifacts. EEG data is almost always contaminated by such artifacts. The amplitude of artifacts can be quite large relative to the size of amplitude of the cortical signals of interest.

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6. CONCLUSION

The B.M.I.s allows those with poor muscle control to communicate and control physical devices. They have high Precision (can be used reliably). There are a few challenges, like, getting the right brain activity codes out for the desired action, getting the appropriate feedback in (sensory, force, visual, vestibular, acoustic, olfactory) deriving algorithms that represent interaction of codes out and feedback in, accessing the codes non-invasively, optimizing the signal to noise over the spatiotemporal scale, and integrating new processes, form, function and materials (actuators, sensors) in devices which can be optimally controlled by the brain.

7. REFERENCES

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