

A Therapy For Nightmares Through Invasive Brain Computer Interface (BCI)

Mrs.Manjula.K¹
Assistant Professor
Department of TCE
S.J.C. Institute of Technology
Chickaballapura, India
manjula.bhagyakrishna@gmail.com

Karunya Somandepalli²
3rd Year B.E Student
Department of TCE
S.J.C. Institute of Technology
Chickaballapura, India
dravidkarz@gmail.com

Sharath V N²
3rd Year B.E Student
Department of TCE
S.J.C. Institute of Technology
Chickaballapura, India
sharathnarayan16@gmail.com

Chandana S²
3rd Year B.E Student
Department of TCE
S.J.C. Institute of Technology
Chickaballapura, India
Chandanas2398@gmail.com

Abstract: Brain Computer Interfacing (BCI) is progression which establishes a correlation or a trail used intended for statement from outside humankind to the mind all the way through the brain signals. There are three popular types of BCI, based on top of the placement of sensors worn for tracing aforesaid signals, which are non-invasive, invasive semi-invasive and invasive. Non-invasive BCI is one where sensors are located on top of the scalp, computing also the electrical potentials shaped with mind that is defined as electroencephalography (EEG) or the magnetic fields by means of a method referred Magneto encephalography (MEG); in partial-invasive BCI electrodes be positioned on top of the bare exterior of the brain in practice referred as Electro corticography (ECoG); in addition to invasive, micro-electrode arrays be positioned in a straight line to cortex. This paper proposes a scheme for invasive BCI process for treatment of nightmares.

Keywords: Brain Computer Interface (BCI), Electroencephalography(EEG), Magnetoencephalography (MEG), Electro corticography (ECoG), Post-traumatic stress disorder(PTSD)

I. INTRODUCTION

Nightmare is a dreadful reverie so as to typically engross a few imaginary hazard or danger towards the human being having it. The being might nightmare concerning hazard or frightening circumstances. Nightmares might engage troubling themes, descriptions and figures like monsters, ghosts, animals, or awful persons. There is no definite picture of why nightmares occur, but the root of most nightmares is trauma which the dreamer would have gone through directly or indirectly, lack of sleep, unhealthy amount of strain, irregular sleep routine, anxiety and sometimes, insecurities. Other than perchance, the mainly considered reason is post-traumatic stress disorder (PTSD). Nightmares be a widespread consequence amid persons anguish as of PTSD and, be solitary of the criterion old intended for the analysis of the chaos. Based on the research, A University of Pittsburgh School of Medicine study, published in 2009 in "Sleep Medicine Clinics," originate to 80% of individuals having recurrent nightmares are those diagnosed with PTSD[1]. A 1998 study that evaluated information as of the National Vietnam Veterans Readjustment Study establish that normal nightmares be reported by 52% of soldiers who survived wars but only by 3% of non-combat, i.e, civilian participants. Not merely are nightmares extra common in individuals with PTSD, they are supplementary recurrent, now and then happening numerous periods a week.

The entire mind is lively throughout nightmares, as of the brain stalk towards the cortex. On the whole nightmares take place through REM (rapid eye movement) sleep. This is fraction of the sleep-wake sequence which is inhibited with the reticular initiating structure whose structures lope beginning the brain stalk from side to side the thalamus to cortex.

II. INVASIVE BCI, A DETAILED STUDY.

Before going into the detailed study of invasive BCI, a brief idea of what BCI actually is outlined below. BCI is frequently referred as Mind-Machine interface (MMI) or every so often as Brain-Machine Interface (BMI). As the name itself very clearly indicates, BCI is nothing but a communication trail amid brain and computer. It is an upcoming technology that aims at enhancing cognitive capabilities or convey-

ing people's ideas to the external world, directly from their thoughts [3]. The field of BCI has been excessively focussing on neuroprosthetics applications, which are restoring damaged hearing, vision and movement.

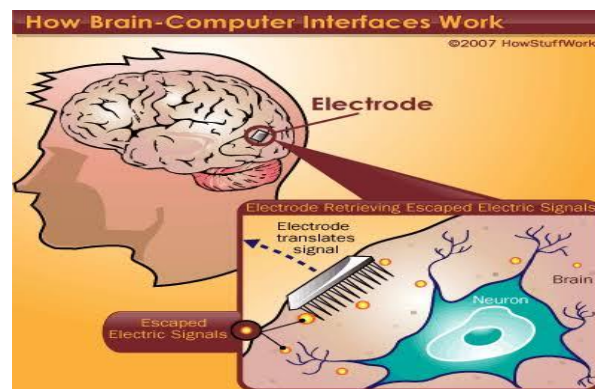


Figure 1: Brain Computer Interface

The invasive BCI plans be individuals which are entrenched openly keen on the human brain and provide the uppermost excellence of signals, with splendid accuracy and minimal amount of disturbances. They are most widely worn to reinstate dream among the blind through involving the mind cells to an outer camera and also to reinstate by making employ of limbs in the paralyzed, through computer forced mechanical arms and legs.

Neurosurgery is a medical operation that is most probably applicable in invasive BCI signal acquisition. Signal acquisition device or a sensor is implanted in the grey substance of the brain. Since they recline inside the grey substance, there is high chance of the signals becoming weaker due to the brain reacting to foreign substances.

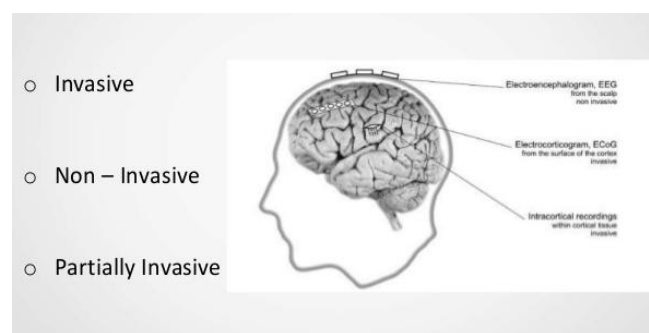


Figure 2. Various techniques for Signal Acquisition in BCI

Shown below is the diagram for invasive BCI system with EEG signal processing methodology

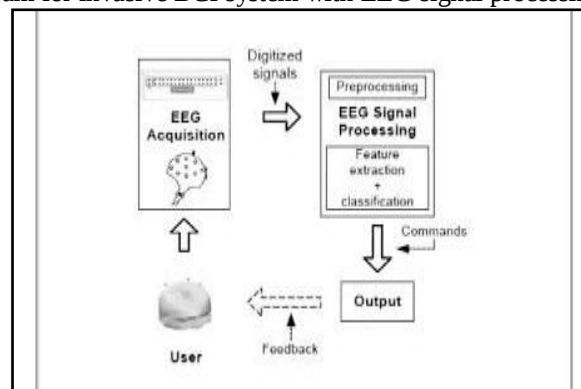


Figure 3. EEG Signal Processing Methodology

III. METHODOLOGY

A. Signal Acquisition

The input signals of BCI maybe EEG is taken from scalp or ECoG recorded by means of subdural electrodes. Here, we suggest the utilize of Wavelet Transform for classification of the motor imagery ECoG functions considered in unlike stages.

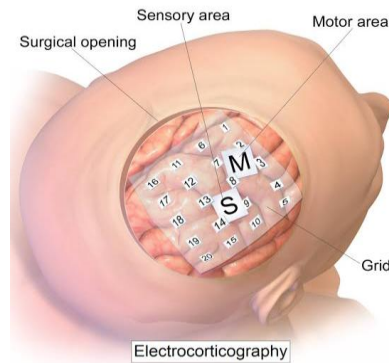


Figure 4. ECoG Acquisition

Wavelet transforms (WT) examine a variety of erratic actions in biomedical meadow. Wavelet Transform is appropriate for changing signals and it's advantageous above phantom examination for time frequency depiction of a indication wavelet is an efficient means. The significant factor of Wavelet transform is that it gives precise occurrence data at the small frequencies and exact time in sequence at the elevated frequencies. This possession is significant in biomedical applications. Since mainly signals in the biomedical field for all time hold far above the ground frequency components by means of little time period and low frequency components with extended time period. WT produces multiresolution analysis of nonstationary signals.

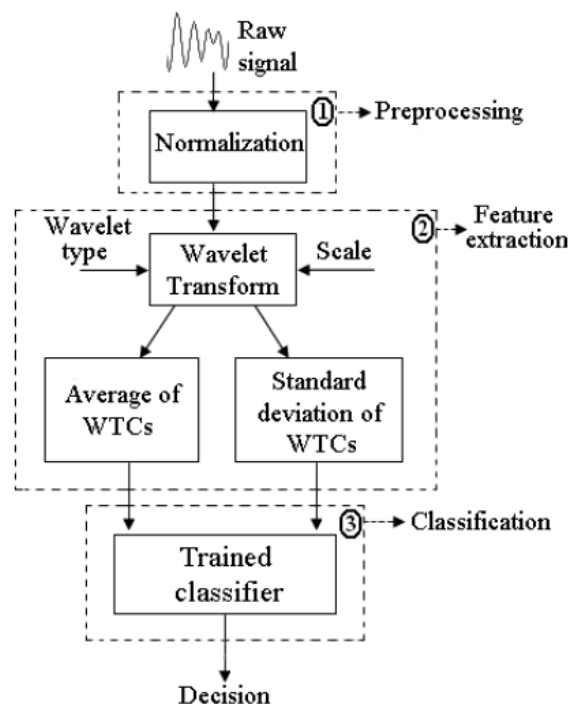


Figure 5. Proposed Methodology

B. Wavelet Analysis for Feature Extraction

The continuous wavelet transform (CWT) is the convolution of the defined signal $x(t)$ with the wavelet function $\psi_{\tau,s}(t)$ and which is defined as

$$CWT_X^\psi(\tau, s) = \frac{1}{\sqrt{|s|}} \int x(t) \psi^*\left(\frac{t-\tau}{s}\right) dt \quad (1)$$

where $\psi_{\tau,s}(t)$ is the time shifted description of the wavelet function $\psi(t)$ and is stated as follows:

$$\psi_{\tau,s} = \frac{1}{\sqrt{s}} \psi\left(\frac{t-\tau}{s}\right) \quad (2)$$

Here t , τ and s presents the time parameter, the shift parameter as well the level parameter, correspondingly. The wavelet function $\psi_{\tau,s}(t)$ has zero mean which is given in equation (3).

$$\int_{-\infty}^{\infty} \psi_{\tau,s}(t) dt = 0 \quad (3)$$

A significant aim of wavelet examination is to select a meticulous wavelet function $\psi(t)$. Amid various wavelets, particular the Morlet wavelet function since which is optly restricted in the frequency field. On top of the former offer the comparison of the wavelet function and the signals to be verified is important to filter in positive information. Compared with other forms of wavelets, the Morlet wavelet is having mainly alike outline to with the intention of the signals which are verified [2].

Wavelet transform is worn by a lot of BCI data analysis uses to pull out feature(s) which has benefits above various other feature extraction methodologies [2].

The Average and standard deviations for wavelet transform are given by

$$WTCs^{Avg} = \frac{\sum |WTCs|}{L_{WTCs}} \quad (4)$$

$$WTCs^{Std} = \sqrt{\frac{\sum (|WTCs| - WTCs^{Avg})^2}{L_{WTCs} - 1}} \quad (5)$$

C. Classification Algorithms

The aspire of such element is to set off the k -Nearest Neighbor as a prevailing classifier used in favour of the revise. The k -NN classifier is a conventional categorization algorithm that gives exposure to hidden aim to the leading set between its k adjoining neighbours inside the characteristic set [4]. Even though k -NN algorithms are not accepted in the BCI area, particularly they are proficient with near to the ground quality vectors [5].

Another classifier SVM targets at calculating a hyper-plane in the characteristic space that concurrently reduces empirical classification faults, peaks the remoteness with hyper-plane and the adjacent information point of every group.

LDA divides into a pair of classes depending on the hypothesis of mutual classes are beneath standard allocation having same covariance matrix. The unscrambling hyper-plane is produced from ledge of the characterized preparation information that peaks the space among pair of classes also tinier the difference. The major aspire is that to resolve the difficulty by considering the vector

$$y = w^T x + w_0 \quad (6)$$

Here x -feature vector.

w and w_0 vectors are found with maximizing of the way and reducing of interclass dissimilarity.

LDA classifier is exceedingly strong compared to the k -NN and the SVM algorithms because it is having merely inadequate elasticity also not as much of tends to above appropriate [6]. Few of the recompense of the LDA and the k -NN classifiers which less complex to adopt and contain an extremely stumpy computational need that makes appropriate for the online BCI system [4], [7], [8].

CONCLUSION

This Review paper provides an apparent examination of invasive BCI and a proposed methodology to use in treating night mares on adults which occur majorly due to post-traumatic stress disorder. The invasive BCI devices record every dream that occurs in the brain, in the form of signals, which are extracted through the Wavelet Transform. And then these signals are converted back to the images and these images are shown to the patient, helping him grasp the concept that those are only his thoughts made into actions by his fear and can be easily controlled by varying his thinking.

REFERENCES

- [1] Anupama H.S, N.K. Cauvery, Lingaraju G.M, “Brain Computer Interface and it's types-a study”,. International Journal of Advances in Engineering & Technology (IJAET), May 2012. ISSN: 2231-1963
- [2] Onder Aydemir, Temel Kayikcioglu, “Wavelet transform classification of invasive brain computer interface data”,. Radioengineering, Vol. 20, No. 1, April 2011
- [3] Mrs. Manjula. K, Dr. M.B. Anandaraju “A comparative study on feature extraction and classification of mind waves for Brain Computer Interface (BCI)”, International Journal of Engineering & Technology, 7 (1.9) (2018), page no. 132-136
- [4] Duda. R..O, Hart, P. E, Stork. D. G, “Pattern Classification”, 2nd edition, New York: Wiley, 2001
- [5] Lotte. F, Congedo. M, Lecuyer. A, Lamarche.F, Arnaldi. B, “A review of classification algorithms for EEG based brain–computer interfaces”, Journal of Neural Engineering, 2007
- [6] Muller. K.R, Anderson. C. W, BIRCH.G. E, “Linear and nonlinear methods for brain-computer interfaces”, IEEE Trans. Neural Syst. Rehabil. Eng. vol. 11, no. 2, page no 165–169, 2003
- [7] Lugger.K, Flotzing. D, Schlogl.A, “Feature extraction for on-line EEG classification using principal components and linear discriminants”, Medical & Biological Engineering & Computing, vol. 36, no. 3, p. 309-314 1998
- [8] Lenhardt.A, Kaper.M, Ritter.H. J, “An adaptive P300- based online brain-computer interface”, IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 16, page no. 121-130, 2008