International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 01 | Jan-2018 www.irjet.net p-ISSN: 2395-0072

Analysis of EEG Signals and Biomedical Changes due to Meditation on Brain: A Review

Kajal S. Korde[1], Prashant L. Paikrao[2]

[1]MTech Student, Department of Electronics & Telecommunication, Government College of Engineering, Amravati, India
[2]Assistant Professor, Department of Electronics & Telecommunication, Government College of Engineering, Amravati, India

---

Abstract - *Meditation can significantly contribute physical and mental relaxation. In modern stressful life meditation is gaining popularity as most feasible solution for stress reduction. Many researchers discovered that a lot of constructive changes have been observed in the brain which is indirectly reflected in the behavior of human being. This survey shows the effect of meditation on human brain using electroencephalograph (EEG) signals and various signal processing methods.*

Key Words: **Meditation, Electroencephalogram, Mantra chanting.**

1. INTRODUCTION

Meditation involves induction of specific modes or states of consciousness. People carried out Yoga Practices and Meditation since long back. Meditation continues to be used as self-mastery and self-help technique along with chanting of mantras bound up with the religious context. In general meditation can be divided into two types: mindfulness and concentrative. Mindfulness based meditation is allowing all your thoughts, feelings and sensations to arise while staying aware of yourself and your location [4]. Recent research has found that mindfulness meditation is associated with an increase in psychological well-being and a decrease in stress and mood disturbance [4]. Mindfulness gives a simple but strong direction for getting ourselves unstuck, back into touch with our own intelligence as well as liveliness [4].

This review includes those meditation techniques, which are well established. There are meditative exercises in which concentration initially plays role and in which ones attention is confined or focused on mantras as in transcendental meditation.

In 1950s it was hoped that the EEG would be the feasible aid for understanding the function of brain. EEG studies have utilized these methods to portray the brainwave changes that occur during meditation. Although the meditative changes in EEG signals have not yet been firmly established, the prior findings have interpreted increases in theta and alpha band power and decreases in overall frequency [1]. For analyzing these EEG signal various Time- Frequency analysis methods are available in the stream of signal processing which are discussed in the later section.

2. ELECTROENCEPHALOGRAPHY (EEG)

The function of electroencephalogram is to detect and amplify the bioelectric potential of the brain by electrodes placed on the surface of the scalp. EEG's can detect changes within a small time frame.

The brainwaves having different frequencies within our brain can be classified as shown below in Table (1) with its mental state and corresponding frequencies.

Frequency	Wave	Mental State
Above 40 Hz.	Gamma	Thinking, integrated thought
13-40 Hz.	Beta	Alertness, focused, integrated, thinking, agitation, aware of self and surroundings
8-12 Hz.	Alpha	Relaxed, non-agitated, conscious state of mind
4-7 Hz	Theta	Intuitive, creative, recall, fantasy, dreamlike, drowsy and knowing
0.1 to 4 Hz.	Delta	Deep, dreamless sleep, trance and unconscious

Table 1: Frequency bands

The Alpha signal physiologically co-relates to relaxed or healing condition. The alpha signal is sub divided into two sub bands as, Low alpha of frequency 8-10Hz: It is mainly associated with inner-awareness of self, mind/body integration. High alpha of frequency: 10-12Hz. It is mainly associated with centering, healing, mind/body connection. The beta signal physiologically co-relates to alert, active, but not agitated, general activation of mind and body functions. The Gamma signal physiologically co-relates with information rich task processing. The Delta signal physiologically co-relates to not moving, low level of arousal. The Theta signal physiologically co-relates to healing and integration of mind or body [3].

3. PROPOSED SYSTEM MODEL

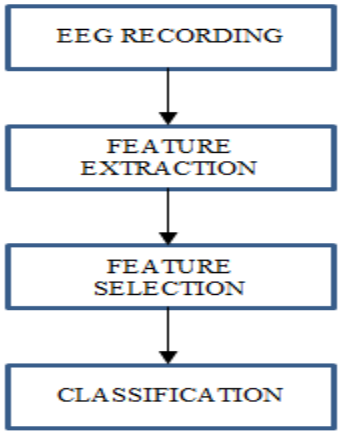

Fig. 1 Proposed System

EEG data are recorded using EMOTIV EPOC+ wireless EEG device on a separate recording laptop. The EEG signal embedded with various artifacts such as eye blinking or movements, muscle artifacts, and power line source. In this work, EEG frequency theta (4–8 Hz), alpha (8–12 Hz) and beta (12–30 Hz) bands are considered hence the influence of eye arti-facts, muscle artifacts and power line artifacts are eliminated. Time domain, frequency domain and time-frequency domain Features are typically calculated from the recorded signal of a single electrode or combination of electrodes. The large amount of possible features makes it necessary to reduce this space in order to avoid over-specification and to make feature computation feasible online. There are various linear and non-linear classifiers are present to divide whole EEG dataset into subsets. Depending on comparison between features of meditational and non-meditational subjects, the effects of meditation on brain can be analyzed. The change in the frequency bands of alpha, beta, theta, and gamma is observed.

4. LITERATURE SURVEY

Prajakta Fulpatil [5] described the effect of meditation for stress relief. The signal recording, filtering and decomposing into different frequency bands was explained in detail.

Sapana M Adhalli [3] explained the effects of Heartfulness meditation and use FFT for the signal pre-processing.

Abdulhamit Subasi, M. Ismail Gursoy [9] compared results of three feature extraction methods; namely PCA, ICA, and LDA with SVM and compare results in terms of accuracy.

M. Rajya Lakshmi [12] presented survey on various methods required for signals processing and Compare different methods of signal pre-processing, signal acquisition, signal enhancement, feature extraction methods and classification techniques.

Laxmi Shaw, Aurobinda Routray [6] classify meditational and non- meditational by using PCA. Kaushik Bhimraj,

Rami J. Haddad [7] described the ICA algorithm for noise filtering.

Nandish. M, Stafford Michahial, Hemanth Kumar P, Faizan Ahmed [10] described the two methods- average method and Max-Min method as feature selection techniques.

Swati Vaid [11] gives the comparison of different classification techniques.

S No.	Year	Author	Title	Work Highlights	Conclusion
1	2010	Abdulhamit Subasi, M. Ismail Gursoy	EEG signal classification using PCA, ICA, LDA and support vector machines	Using statistical features extracted from the DWT sub-bands of EEG signals, three feature extraction methods; namely PCA, ICA, and LDA were used with SVM and cross compared in terms of their accuracy.	It is demonstrated that dimension reduction by PCA, ICA and LDA can improve the generalization performance of SVM.
2	2012	Nandish. M Stafford Michahial Hemanth Kumar P Faizan Ahmed	Feature Extraction and Classification of EEG Signal Using Neural Network Based Techniques	After extracting the features from two methods Average method and Max_Min method. The comparison is done between these two models and performance is checked by classifying the data using this two methods the classifier work is done by Neural Network.	Max_Min feature extraction method gives better accuracy compared to the Average Feature Extraction Method.
3	2014	M. Rajya Lakshmi Dr. T. V. Prasad Dr. V. Chandra Prakash	Survey on EEG Signal Processing Methods	This survey give a way to select methods required for processing signals. It discusses methods like 1) Signal Acquisition 2) Signal Enhancement 3) Feature Extraction 4) Signal Classification	With the adequate knowledge of efficient methods with mingled characteristic to always attain better performance can be developed.
4	2014	Mandeep Singh Ankita Sandel Mooninder Singh	Data Acquisition Technique for EEG based Emotion Classification	This paper includes the various data acquisition technique	Processed data is used to classify emotions along valence axis.

5	2014	Prajakta Fulpatil Yugandhara Meshram	Analysis of EEG Signals with the effect of Meditation	The EEG signal is analyzed using Wavelet Transform. The Daubechies8 wavelet is used for extracting the features from EEG signal.	Compare power levels of different frequency bands and comparison shows that the lower frequencies are dominant while as compared to the high frequencies which are more dominant in a non-mediating subjects
6	2015	Swati Vaid Preeti Singh Chamandeep Kaur	Classification of Human Emotions using Multi-wavelet Transform based Features and Random Forest Technique	Study shows comparison of different classifier techniques such as Random Forest method, MLP classifier, KNN classifier with k=2, MC-SVM (Puk Kernel) classifier.	The experimental results indicate that Random Forest has provided accuracy of 98.1% which is higher than other methods used.
7	2016	Shakshi Ramavtar Jaswal	Brain Wave Classification and Feature Extraction of EEG Signal by using FFT on Lab View	For EEG signal filtering FIR band pass Butterworth filter is used. The features are extracted by using FFT power spectral analysis. The FFT is used for increasing the speed and reduction of the time consumption in mathematical calculation.	As EEG signal is of very low frequency components and contains different types of artifacts, the signals are filtered by using FIR Butterworth filter and extracted important information with the help of efficient DSP tool FFT.
8	2016	Sapana M Adhalli H Umadevi Guruprasad S P Rajeshwari Hegde	Design and Simulation of EEG Signal Analysis	The EEG signals are processed by using Matlab and the results are analysed by using Histogram.	The meditation level from simulation and histogram it is very clear that meditation level in both meditator and non-meditator start becoming steady during and after meditation and attained good relaxed condition.
9	2017	Kaushik Bhimraj Rami J. Haddad	Autonomous Noise Removal from EEG Signals Using Independent Component Analysis	In this paper, an autonomous system was presented which explored fixed threshold and variable Threshold parameters to filter noise artifacts in the ICA algorithm network.	The noise filtered EEG data acquired from these two techniques were used for classification utilizing an artificial neural. There was slight improvement in classification when using both autonomous noise extracting features.
10	2016	Laxmi Shaw Aurobinda Routray	Statistical Features Extraction for Multivariate Pattern Analysis in Meditation EEG using PCA	The brain activity pattern is studied in the context of the statistical feature from the meditative EEG and in the resting state EEG. The statistical features are extracted to do a comparative study during a cognitive action such as meditation and non-meditation state.	It is concluded that there is a remarkable Brain state changes across all bands of the EEG signals.

5. CONCLUSION

e present review we studied effects of meditation on brain, various types of signal processing techniques, classification methods, feature selection methods and frequency bands of EEG signal. Wavelet analysis is used to decompose signal into number of sub-bands and features are extracted by using statistical approach.

REFERENCES

1. Delmonte M. M. "Factor influencing the regularity of meditation practices in clinical population" Br. J. Med. Psychol 57: 275–278, 1984.

2. Prajakta Fulpatil, Yugandhara Meshram "Analysis of EEG Signals with the Effect of Meditation", IJERT, Vol. 3 Issue 6, June – 2014 ISSN: 2278-0181.

3. Sapana M Adhalli, H Umadevi, Guruprasad S P, Rajeshwari Hegde, "Design and Simulation of EEG Signals Analysis - A Case Study", IJESC, 2016, ISSN 2321 3361.

4. Seema S. Kute, Sonali B. Kulkarni, "Review on Effect of Mindfulness Meditation on Brain through EEG

   Signals", International Journal of Engineering Research and General Science, Vol. 4, Issue 4, July-August, 2016, ISSN 2091-2730.

5. Prajakta Fulpatil, Yugandhara Meshram, "Review on Analysis of EEG Signals with the Effect of Meditation", IJERA, ISSN: 2248-9622, Vol. 4, Issue 6, June 2014, pp.51-53.

6. Laxmi Shaw, Student Member, IEEE and Aurobinda Routray, Member, IEEE "Statistical Features Extraction for Multivariate Pattern Analysis in Meditation EEG using PCA", IEEE Trans. 2016.

7. Kaushik Bhimraj, Rami J. Haddad, "Autonomous Noise Removal from EEG Signals Using Independent Component Analysis", IEEE Transaction on biomedical Engineering, 2017.

8. Mandeep Singh, Ankita Sandel, Mooninder Singh, "Data Acquisition Technique for EEG based

Emotion Classification", IJITKM, Vol. 7, Jan-June 2014, ISSN 0973-4414.

9. Abdulhamit Subasi, M. Ismail Gursoy, "EEG signal classification using PCA, ICA, LDA and support vector machines", ELSEVIER, 2010.

10. Nandish. M, Stafford Michahial, Hemanth Kumar P, Faizan Ahmed, "Feature Extraction and Classification of EEG Signal Using Neural Network Based Techniques", IJEIT, Vol. 2, Issue 4, Oct. 2012.

11. Swati Vaid, Preeti Singh, Chamandeep Kaur, "Classification of Human Emotions using Multi-wavelet Transform based Features and Random Forest Technique", Indian Journal of Science and Technology, Vol. 8, Oct. 2015.

12. M. Rajya Lakshmi, Dr. T. V. Prasad, Dr. V. Chandra Prakash, "Survey on EEG Signal Processing Methods", IJARCSSE, Vol. 4, Issue 1, Jan.2014.