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Effect of OM Chanting on Brain through EEG Signal Analysis

Harshita Vikramsingh Rajput[1], Rushali Rajendra Kalugade[2], Prajakta Bhagwan Patil[4]
[1, 2]*Students of Nanasaheb Mahadik College Of Engineering, Peth,*
[3]*Assistant Professor of Nanasaheb Mahadik College Of Engineering, Peth*

Abstract: ***Electroencephalography (EEG) signals is an important tool in neuroscience. The behavior of human body can be controlled by millions of neurons present in human brain. EEG is an efficient modality which helps to acquire brain signal corresponds to the various states from scalp surface area. EEG is nothing but the electrical activity of brain. As we know meditation is important since the old days. Meditation can impact more on our brain signal. Recently, the brain signal has made powerful attention towards brain diseases like depression, memory loss, stress etc. Therefore, this work aims to study the importance of OM Meditation which could be very marvel for the people who are under the strain and also who are annoyed with daily routine. In this work, analysis of OM chanting signal before and after and classification is carried out, to verify the significance of meditation. The process involves major two steps: first step is to pre-process or extract the features and second stage is to apply machine learning algorithms. The performance of these methods can be assessed by OM chanting data and quantitative metrics such as accuracy, sensitivity, precision.***
Keywords: ***EEG Signal, OM Chanting, Machine learning, Brain, DWT***

I. INTRODUCTION

The human brain comprises millions of neurons that play a vital role in controlling the body's behaviour in response to internal or external motor and sensory stimuli. These neurons serve as carriers of information between the brain and the body. Understanding the brain's cognitive behaviour can be achieved by analyzing signals or images obtained from the brain. The behaviour of humans can be observed in terms of motor and sensory states such as eye and lip movements, memory, attention, and hand movements. Specific signal frequencies associated with these states aid in comprehending the functional behaviour of the intricate brain structure. Electroencephalography (EEG) is an extremely efficient technique to capture brain signals that correspond to different states from the scalp surface area. EEG is a non-invasive method of recording the spontaneous electrical activity of the brain. Electrodes are placed along the scalp using the International 10-20 system or variations of it. In contrast, intracranial EEG involves surgical placement of electrodes. The most common way of interpreting EEG recordings in a clinical setting is by visually inspecting the traces or performing quantitative EEG analysis. EEG bioamplifiers and electrodes measure voltage fluctuations to evaluate normal brain activity. As EEG measures the electrical activity generated by neurons in the brain tissue beneath the scalp, the recordings obtained by electrodes on the scalp surface show variation based on their distance and orientation from the source of activity.

As we know, Meditation, a component of yoga, involves consciously and willingly directing one's attention for relaxation or personal development. It can be classified into two types: the first type involves focusing on a specific object, while the second type involves mentally or audibly repeating a chant known as mantra meditation. Various mantras can be chosen for the practice of meditation. Employing mantra repetition is a straightforward approach to achieving a meditative state.

The practice of mantra meditation is uncomplicated. The "OM" Mantra holds great significance as the most sacred symbol in Hinduism. This study examined the temporal changes in brain oscillations during OM mantra meditation. The presence of the Om syllable in Upanishads, Bhagvat Gita, and Vedas contributes to its sanctity, establishing it as the highest sacred symbol in Hinduism. Om, recognized as the name of God, is a sacred sound syllable from which all other sounds originated. Numerous benefits of Om meditation have been discovered through studies that employed advanced mathematical analysis and medical tests to evaluate its impact on the human body.

II. LITERATURE REVIEW

Das, I., & Anand, H. (2012). “Effect of prayer and OM meditation in enhancing galvanic skin response.” conducted a study using prayer and meditation, particularly through Om chanting, to investigate their impact on galvanic skin response (GSR) in 20 healthy female participants aged 18 to 24 years, resulting in significant GSR increases and suggesting psychophysiological relaxation, ultimately reducing stress levels. [1]

Harne, B.P. & Hiwale, A.S. (2018). "EEG Spectral Analysis on OM Mantra Meditation: A Pilot Study" In this research she different wavelet techniques were employed to analyze the impact of OM mantra meditation on the brain. Through EEG spectral analysis, it was discovered that OM meditation induces a state of reduced psycho-physiological arousal, enhancing awareness and attention, as evidenced by an increase in theta power. [2]

Telles, S., Nagarathna, R., & Nagendra, H. R. (1995). "Autonomic changes during 'OM' meditation." In this paper analysis The Paper examines the changes in autonomic and respiratory variables during OM mantra meditation and control session. [3]

Telles, S., Nagarathna, R., & Nagendra, H. R. (1998). "Autonomic changes while mentally repeating two syllables-one meaningful and the other neutral." This work on Autonomic changes while mentally repeating two syllables-one meaningful and the other neutral. This study aimed to investigate the effect of mentally repeating a meaningful syllable 'OM' on autonomic and respiratory variables in comparison to a neutral word, 'one', and non-targeted thinking. [4]

Das, K., & Anand, K. (2022). "Assessment of chanting effect using EEG signals by Fourier Bessel Series Expansion technique: Hare Krishna Mantra meditation." This paper presents the rapid growth in population and the scarcity of land tends to development of construction technology and high rise building the single column building compares with the structure with regular column. [5]

Das, K., & Anand, K. (2022). "Assessment of chanting effect using EEG signals by Fourier Bessel Series Expansion technique: Hare Krishna Mantra meditation." This paper investigates the impact of chanting the 'Hare Krishna Mantra' (HKM) on EEG rhythms. The study compares the relative band power of different EEG rhythms before and after one round of HKM chanting (108 times) and utilizes a non-stationary signal decomposition tool, Fourier-Bessel series expansion, to calculate the band power. The results indicate a significant increase in alpha band power after meditation, suggesting a relaxed and peaceful state of mind. This investigation into the effects of HKM chanting on EEG rhythms may offer a simple yet effective approach for managing stress, depression, tension, and other related conditions. [6]

III. OBJECTIVE

1) To study the brain signal database.
2) To study and perform the feature extraction using discrete wavelet transform.
3) To classify the OM chanting effect before and after meditation using machine learning techniques.
4) To calculate the accuracy, sensitivity, precision of the EEG signal.

IV. METHODOLOGY

A. *Project Methodology*

V. RESULTS

Feature Extraction Results for Two signals

Sr. No.	Features	BM	AM
I.	Mean	-0.0008	-0.1469
II.	Variance	1.9485	563.8731
III.	Standard Deviation	0.0441	23.746
IV.	Kurtosis	0.072	13.3033
V.	Skewness	0.0003	-0.0235

Fig.1 Feature extraction foe signal 1

Sr. No.	Features	BM	AM
I.	Mean	-0.0002	-0.0002
II.	Variance	1.0836	2.5428
III.	Standard Deviation	0.0329	0.0504
IV.	Kurtosis	0.0075	0.0143
V.	Skewness	-0.0001	-0.0005

Fig.2 Feature Extraction for signal 2

Machine Learning Algorithm Classification Results

ML Algorithm	Meditation	Precision	Recall	TP rate	FP Rate	Accuracy
Bayes	BM	0.452	0.609	0.609	0.739	43.4783
	AM	0.4	0.261	0.261	0.391	
Naïve Bayes	BM	0.55	0.957	0.957	0.783	58.6957
	AM	0.833	0.217	0.217	0.043	
LibLINEAR	BM	0.514	0.826	0.826	0.783	52.1739
	AM	0.556	0.217	0.217	0.174	
LibSVM	BM	0.552	0.696	0.696	0.565	56.5217
	AM	0.588	0.435	0.435	0.304	
Logistic	BM	0.55	0.478	0.478	0.391	54.3478
	AM	0.538	0.609	0.609	0.522	
SGD	BM	0.537	0.957	0.957	0.826	56.5217
	AM	0.8	0.174	0.174	0.043	
SMO	BM	0.556	0.87	0.87	0.696	58.6957
	AM	0.7	0.304	0.304	0.13	
LWL	BM	0.529	0.783	0.783	0.696	54.3478
	AM	0.583	0.304	0.304	0.217	
Multi class classifier	BM	0.55	0.478	0.478	0.391	54.3478
	AM	0.538	0.609	0.609	0.522	
ZeroR	BM	0.452	0.609	0.609	0.739	43.4783
	AM	0.4	0.261	0.261	0.391	
Decision Stump	BM	0.529	0.783	0.783	0.696	54.3478
	AM	0.583	0.304	0.304	0.217	
NB Tree	BM	0.455	0.652	0.652	0.783	43.4783
	AM	0.385	0.217	0.217	0.348	
Random Forest	BM	0.536	0.652	0.652	0.565	54.3478
	AM	0.556	0.435	0.435	0.348	
REP Tree	BM	0.483	0.609	0.609	0.652	47.8261
	AM	0.471	0.348	0.348	0.391	
Logistic regression	BM	0.537	0.957	0.957	0.826	56.5217
	AM	0.8	0.174	0.174	0.043	

Graph for Classification Parameters after applying Machine Learning Algorithm for before and after meditation

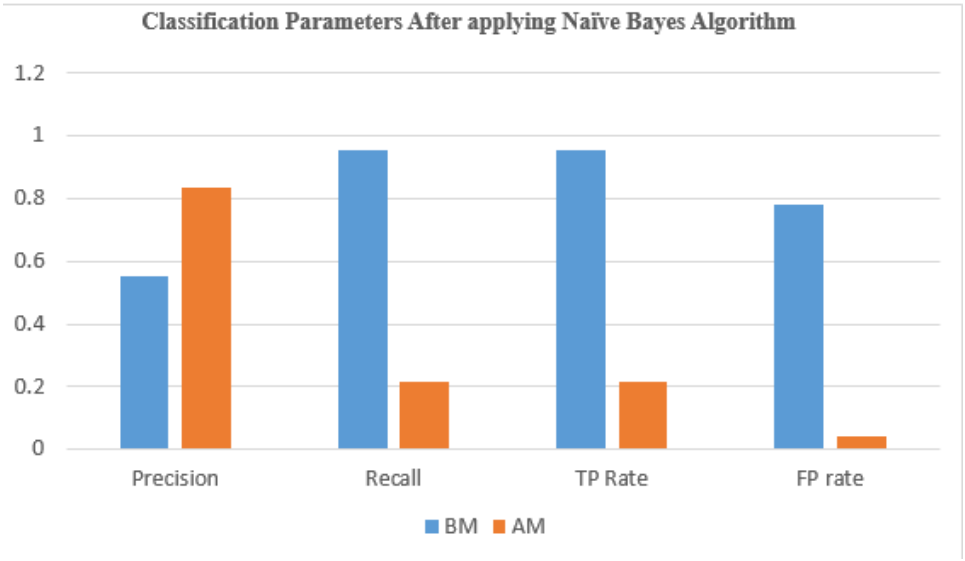

Fig.3 Classification Parameters after applying Machine Learning Algorithm

In general, during meditation or chanting practices, the goal is often to achieve a state of deep relaxation and mental focus. High precision in the EEG signals may indicate that the brain is achieving a state of deep relaxation and focused attention.

Recall, in the context of signalling, refers to the ability of a signalling molecule or pathway to trigger a cellular response even after the initial stimulus has been removed. if the goal is to promote creativity or expand consciousness, low recall may be desirable to allow for a greater degree of mental flexibility and exploration. TP rate refers to the true positive rate, which is a measure of the proportion of correctly identified EEG signals related to the Om mantra. if the goal is to investigate the relationship between EEG signals and creativity or divergent thinking, a lower TP rate may be more appropriate. This is because divergent thinking involves generating a wide range of possible solutions or ideas, rather than focusing on a specific target or stimulus. FP rate refers to the false positive rate, which is a measure of the proportion of incorrectly identified EEG signals as related to the Om mantra. if the goal is to investigate the effects of the Om mantra on brain activity and relaxation, a low FP rate would be important to accurately capture the neural activity associated with the practice.

Graph of Accuracy of different Machine Learning Algorithm for Analysis of EEG signal

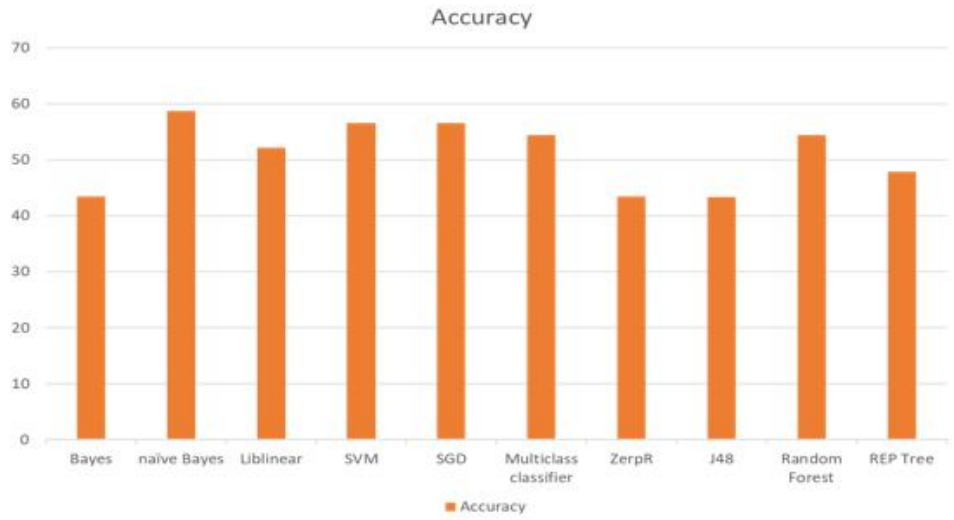

Fig.4 Accuracy of different Machine Learning Algorithm for Analysis of EEG signal

VI. CONCLUSION

EEG Feature Extraction of OM mantra meditation has provided valuable insights into the neurophysiological effects of this ancient practice. The findings suggest that OM mantra meditation induces changes in brain activity that are indicative of a state of deep relaxation, heightened focus, and increased self-awareness. The use of machine learning techniques for the classification of EEG signal has shown promising results in recent research. By applying various machine learning techniques, we were able to classify pre- and post-meditation data with high accuracy. After analyzing the classification through machine learning algorithms, we discovered that the Naive Bayes machine learning algorithm provides higher accuracy when classifying before and after meditation data. The results suggest that meditation can induce changes in brain activity, which can be detected and measured through EEG signals. This study highlights the potential of machine learning algorithms in analyzing EEG data to understand the effects of meditation on the brain.

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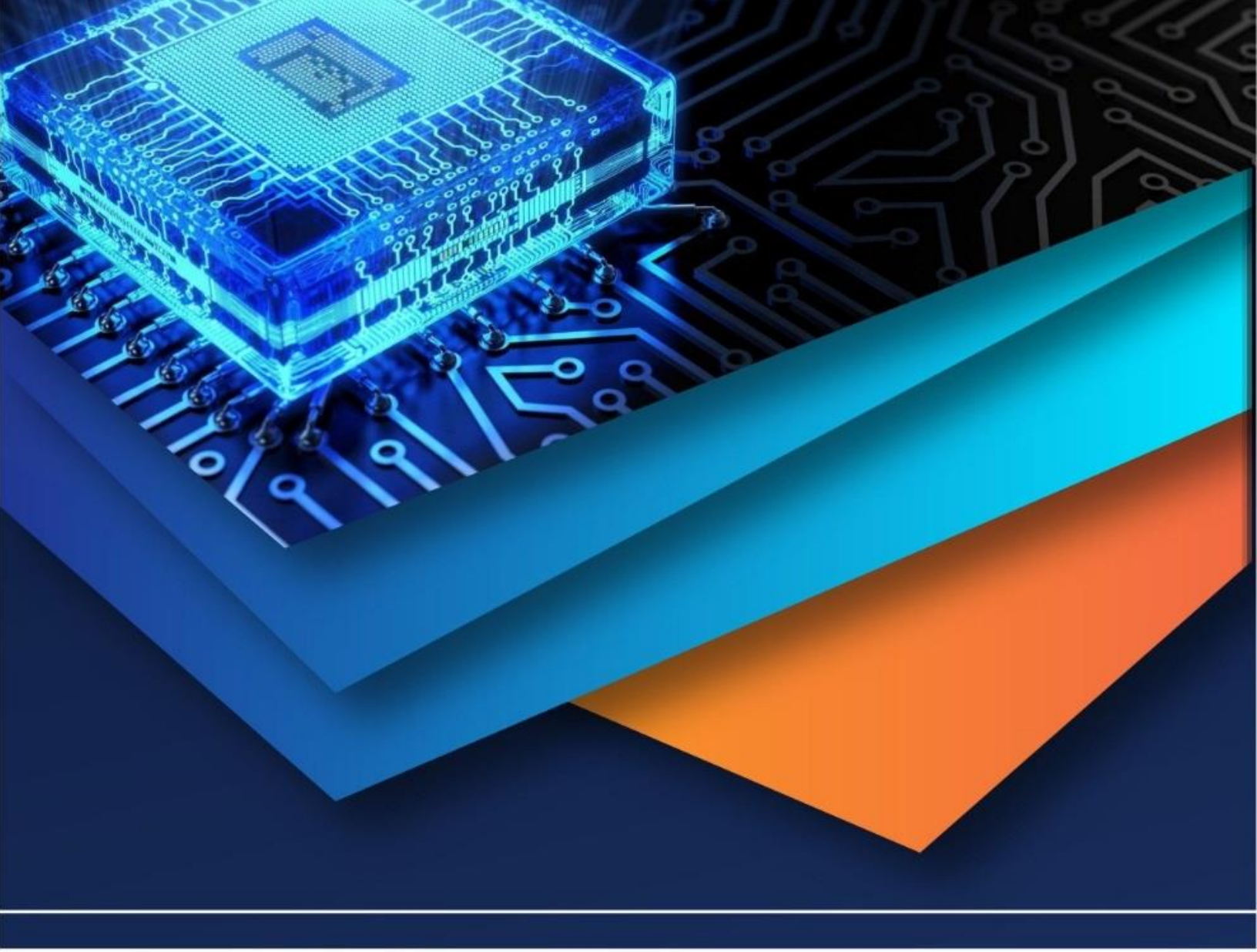

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