

Advanced Study of ICA in EEG and Signal Acquisition using Mydaq and Lab view Application

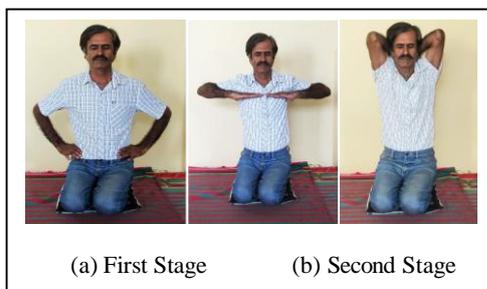
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Abstract: *Electroencephalography is the account of electrical movement along the scalp of an individual. This enables us to gauge mind action associated with different sorts of subjective capacities. Exploratory objective of this work is to decipher and portray the EEG movement amid Pranayama breathing as for transient and spatial setting, and get two channel information utilizing MyDAQ and Labview. This work basically investigates the variety in the EEG wave design amid various phases of Pranayama just as the variety of alpha wave level in the left and right frontal, fleeting parietal and occipital areas of the cerebrum. Factual hugeness test is performed for various cycles of Pranayama to gauge the critical change in the alpha power as for pattern measures. An exertion was had to break down the effect in the cerebral electrical action among long haul and transient reflection professionals. Information was recorded for ten subjects amid three cycles of Pranayama, each cycle going on for two minutes. So as to quantify the impacts towards the finish of Pranayama, the most recent 20 seconds of EEG information were dissected in each cycle of Pranayama. The investigation uncovered that 40 % of the subjects were loose (implies increment in alpha power) just as alarm (implies increment in beta power) toward the finish of Pranayama, while 30% of the subjects demonstrated diminishing in beta power. Likewise, 10% indicated increment in beta power for just a single cycle. Subsequently, one may reason that the act of Pranayama improves unwinding and discernment, driving the professionals to a calm and solid life.*

Keywords: *Electroencephalogram, Lab view, Independent Component Analysis, Data Acquisition, Artifact.*

I. INTRODUCTION

There is developing enthusiasm for the joining of contemplation in clinical applications for treatment and in the instruction field to have the advantages of reflection. This work exhibits the proof identified with the neuro physiological changes amid contemplation. Contemplation encourage to accomplish instructive objectives, expands understudy mental gauge notwithstanding scholastic pressure, and to upgrade the very way of life of the individual. To put it plainly, contemplation contributes significantly towards making the best intellectual preparing programs.



The Pranayama is gotten from two Sanskrit words 'Prana' and 'ayama', where 'Prana' signifies Energy or life and 'ayama' signifies prolongation of life expectancy. The word Pranayama, in this manner, implies extension of pranic vitality. There are three Stages of Pranayama utilized in the sacred texts [1-3]. They are: first Stage: 8-10 times Ujjai breath (which means profound), Posture: Vajrasana, Thumbs on the hip bone, Palms parallel to the ground, spine erect pursued by 30-45 seconds Relaxation. This is appeared in Figure 1a. second Stage: 8-10 times Ujjai breath (Posture: Vajrasana, Thumbs under arm pits, Palms parallel to the ground, spine erect) as appeared in Figure 1b and pursued by 30-45 seconds Relaxation. third Stage: 8-10 times Ujjai breath (Posture: Vajrasana, palms on the back, biceps contacting the ear and elbow indicating the roof, spine erect, jaw at the typical dimension), trailed by 30-45 seconds Relaxation. This is appeared in Figure 1c. Amid ordinary breathing, we utilize just a large portion of the lung limit, which can be effectively comprehended by taking a full breath filling the whole lungs. Amid the act of Pranayama, we use in any event 80% of our lung limit. More profound the breath more is the oxygen entering the blood, in this manner profiting each platelet and thusly the entire body. The brain and the breath have a typical source, which implies our contemplations and breath are straightforwardly related. For example, when we are furious or eager, the quantity of breaths every moment likewise increments quickly. By controlling the breathing, one can control pointless contemplations and furthermore the feelings, helped significantly by the act of Pranayama. To put it plainly, on the off chance that breath is controlled, at that point the contemplations are likewise controlled.

Fig. 1 Pranayama in Vajrasana Posture (a) First Stage: Adhama, (b) Second Stage: Madhyama (c) Third Stage: Uttama An exertion was made to break down the cerebral electrical action for ten subjects. EEG is recorded amid deliberation as a benchmark and three cycles of Pranayama. It is a moderate and quick breathing activity. This work is an endeavor to score the impact of Pranayama by considering the variety in EEG voltage levels [4]. A large portion of the alluded papers have not displayed quantitative examination [1-8]. Papers on Meditation alluded before have performed either cognizance or subjective investigation and information has been procured just for 4 or 5 subjects In this way, point of our work is to play out a definite quantitative and subjective investigation getting information for 10 subjects, offering better outcomes. EEG flag contains five low recurrence groups, in particular, Alpha (8-13 Hz), Beta (14-30 Hz), theta (4-8 Hz), Delta (0.5-4 Hz) and Gamma (over 30 Hz). Our goal is to complete a quantitative examination of these groups amid Pranayama.

EEG information for ten subjects was obtained utilizing a RMS Recorder with 10-20 Electrode framework. This information was changed over into a 32 channel information by setting to a vertical regular Average Reference.

The 32 Channel information is utilized to get a Topo plot for further information investigation. fourth request Elliptic channel is connected for the obtained EEG information to remove EEG waves, to be specific Delta (beneath 3 Hz), Theta (4-7 Hz), Alpha (8-13 Hz), Beta (14 Hz or more). Through Fast Fourier Transform, control in each wave is determined [5-8].

Free Component Analysis (ICA) is a very ground-breaking higher request measurable method and can isolate autonomous sources straightly blended in a few sensors. For example, when recording electroencephalograms (EEG) on the scalp, ICA can isolate out antiques installed in the information (since they are normally free of one another). An initial phase in numerous ICA calculations is to brighten (or circle) the information. This implies we evacuate any connections in the information, i.e., the diverse channels are compelled to be uncorrelated.

The distinguishing proof of autonomous parts from EEG flag sees better the wellsprings of EEG flag. This was shown by Hyvarinen An et al. [9]. Settling of the wellsprings of curios and the wellsprings of helpful signs are managed in his work. The utilization of Independent Component Analysis as a dynamic strategy for expelling ancient rarity from EEG flag was introduced by Bell A. et al. [10].

The work has helped in recuperation of epileptic pinnacle specialists. EEG is recorded by International standard 10-20 Electrode framework utilizing Recorders Medicare Systems with 24 channel advanced EEG machine having an A/D change of 16 bits with inspecting recurrence of 256 Hz, Software form of Super Spec. 4.2.54. Here, 10-20 signifies the position of the terminals in a specific way as appeared in Figure 2.

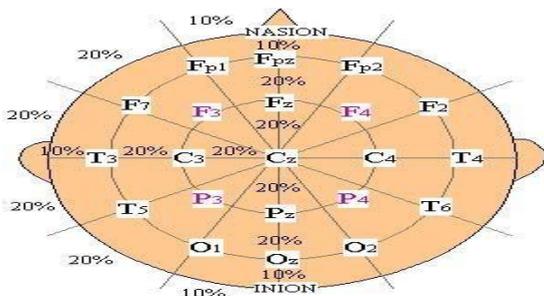


Fig. 2 Placement of International Standard 10-20 Electrode

sources, unconstrained movement sources and different grapho components as K-buildings and rest axles. The utilization of EEG signs to gauge subjective state was proposed by Boscolo R. et al. [11].

The estimation was finished utilizing a common data based technique. Order was done in their work by utilizing a gathering of three classifiers and utilizing larger part casting a ballot rationale. In any case, the issue of finding powerful highlights that permits cross-session and cross-subject speculation are not talked about in their work.

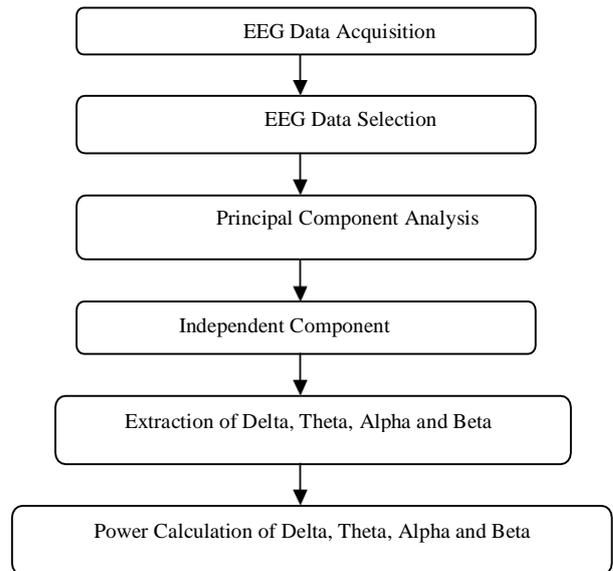
The joined utilization of ICA for pre-preparing the EEG flag, Discrete Wavelet Transform investigation for highlight extraction and fluffy group implies calculation for acknowledgment of certain illnesses were proposed by Delorme An et al. [12].

Quantitative examination of EEG signals is a test in the subjective appraisal or for analytic Applications. In this work, ICA is executed for ancient rarity evacuation and for source localization.

This paper is sorted out as pursues. In area two, the technique of EEG handling is displayed in detail. Area three presents results. At long last, end is drawn.

ACQUISITION OF EEG SIGNAL AND ANALYSIS

EEG signals were obtained for ten ordinary subjects between the age gathering of 25 to 40 years. Five of them are rehearsing Pranayama for over eight years, considered as long haul Practitioners; generally taken as transient



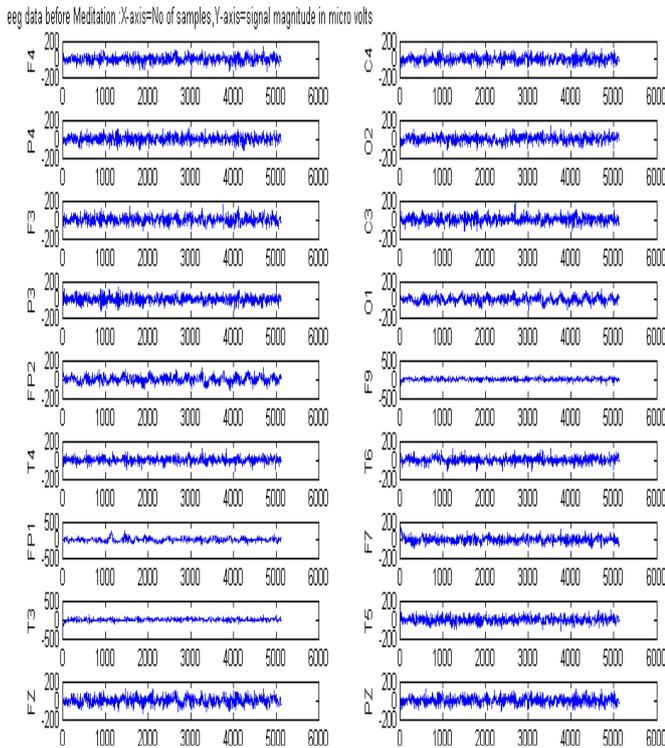


Fig. 3 Display of 18 Channel EEG Data X axis: No. of samples; Y axis : Amplitude in μ volts

EEG is recorded amid Pre Meditation organize for initial 5 minutes with eyes shut and pursued by 3 cycles of anayama for six minutes. EEG information for most recent 20 econds from each cycle of Pranayama is taken for examination. EEG information procured from a 10-20 framework has 18 diverts as appeared in Figure 3; the vast majority of the channels having excess information. Important Component Analysis (PCA) is connected on the procured information for dimensionality decrease.

By applying Principal segment examination, we get "Scree" plot, from which it is discovered that 5 channels that have most extreme EEG plentifulness varieties are satisfactory for investigation as appeared in Figure 4.

In any case, PCA does not distinguish which of the 18 channels have greatest EEG plentifulness varieties. The Independent Component Analysis is connected to locate the Maximum EEG variety channels. In this work, Independent Component Analysis is actualized utilizing EEG LAB open source programming [13].

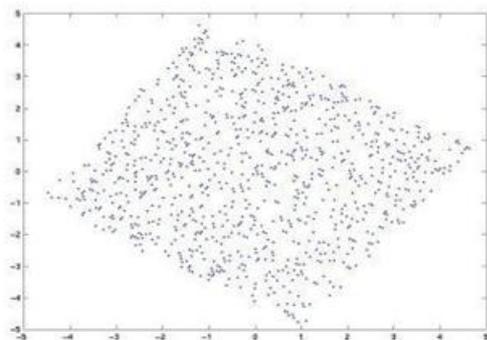


Fig. 4 Functional procedure for EEG Data Acquisition and Analysis

The objective of this work is to translate and portray the EEG movement amid Pranayama regarding fleeting and spatial setting. This work essentially investigations the variety in the EEG wave design amid various cycles of Pranayama just as variety of alpha wave control in various

locales of the cerebrum.

Recording Conditions were set for the subjects to be truly agreeable. Subjects ruminated with their eyes shut in a sitting position in a room free of sound and visual diversions.

EEG movement is unpredictable in nature. In this way every exertion has been made to limit the antiques that may influence examination and results. The Methodology executed is to decipher the recurrence waves, for example, Delta, Theta, Alpha, and Beta that describe the mind state.

The examination depends on these particular recurrence extends so as to decipher the progressions that happened amid reflection.

Free Component Analysis: A cathode detecting a flag at a position might be impacted by the signs grabbed by neighboring anodes. ICA is a very amazing procedure which is equipped for getting the ideal signs sifting through the undesirable neighboring signs.

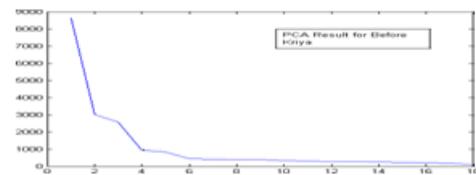
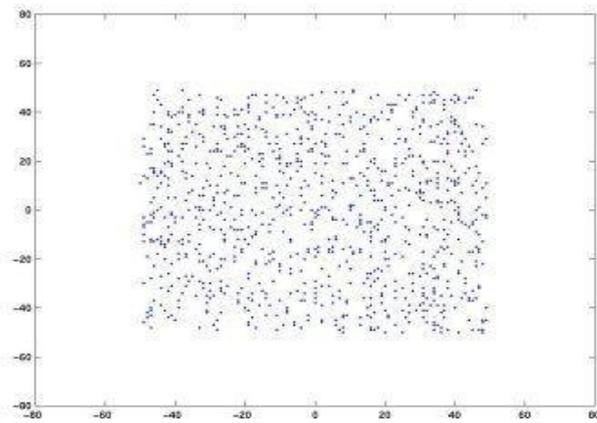


Fig.5 Screen Plot: Variance vs Channel in an EEG Data

ICA can isolate out antiques installed in the information since they are generally autonomous of one another. An initial phase in ICA calculation is to focus an information by subtracting each channel information from its mean esteem. This is alluded to as "white" or "circle". Brightening the information is a Pre-preparing step performed by most ICA calculations before applying ICA. This progression expels any connections in the information, i.e., all channels are compelled to be uncorrelated. A geometrical translation for two blended arbitrary sinusoidal sources An and B with various amplitudes and frequencies is appeared in Figure 6, where the two signs are directly blended. This outcomes in Gaussian dispersion. In the event that we brighten the two straight blends, we get the plot as in Figure 7. The fluctuation on the two tomahawks is presently equivalent and the relationship of the projection of the information on the two tomahawks is 0, implying that the covariance network is corner to corner and that all the askew components are equivalent. The brightening procedure is basically a direct difference in facilitate of the blended information. When the ICA arrangement is found in this "brightened" facilitate outline, we can without much of a stretch re venture the ICA arrangement once more into the first organize outline. The objective of this work is to translate and portray the EEG movement amid Pranayama regarding fleeting and spatial setting.



This work essentially investigations the variety in the EEG wave design amid various cycles of Pranayama just as variety of alpha wave control in various locales of the cerebrum.

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Fig. 6 mixed Random sources A vs B

ICA parts are orchestrated as a framework that permits anticipating the information in the underlying space to one of the pivot found by ICA. The weight grid is the full change from the first space. The free part space might be communicated as $S = W X$, where W is the weight grid going from S space to the X space. X is the gained

Fig. 7 bleaching of the A and B Mixed Data

information in the first space and S is the source movement. The columns of W are the vector with which we can register the movement of one autonomous part. To register, the part movement in the recipe $S = W X$, the weight framework W is the blending grid. The movement of the Brain source S (likewise called "dipole") is unit-less except if it is anticipated to the terminals. Every dipole makes a voltage motion at every cathode site, which can be estimated. To re-venture one segment to the terminal space, we use $X = W^{-1}S$, where W-1 is the converse grid to go from the source space S to the information space X. Lines of the S network are the time data of the part movement and sections of the W-1 grid are the scalp projection of the segments. We indicate the segments of the W-1 grid as the scalp geology of the parts. Every segment of this lattice is the geology of one part which is scaled in time by the movement of the segment. The scalp geology of every part can be utilized to assess the equal dipole area for this segment. These top-plots are utilized to extricate the most vital five channels which have indicated greatest variety in the EEG abundance.

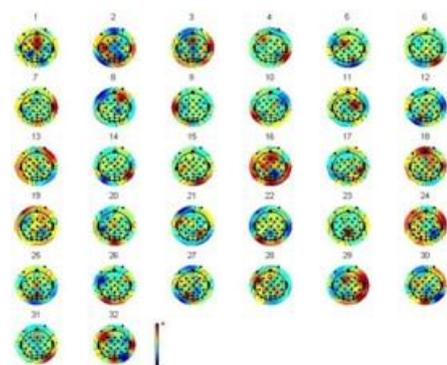


Fig. 8a Topo-plot at the beginning of 1st stage of Pranayama

Topo-plot for one subject at the beginning and at the end of Pranayama for 20 seconds are plotted using EEGLAB Open source software that runs on MATLAB Software and are shown in Figure 8a and Figure 8b respectively.

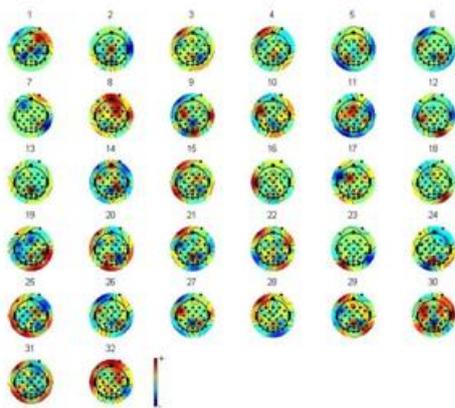


Fig. 8b: Topo-plot at the End of 3rd stage of Pranayama

Blue to Red shading varieties in the Topo-plot demonstrate Electric Field potential varieties from least to max estimation of EEG signals spoke to as a vertical bar with + and – in the figure. By examination of the plots amid pre and post Pranayama organize, it is seen that there is a slow increment in the field possibilities in frontal and occipital areas towards the finish of Pranayama for certain channels.

Channels 1, 8, 30, 31, 32 show increasingly Electrical action in frontal and occipital areas of the cerebrum after Pranayama. These channels are utilized for separating diverse EEG waves. By utilizing elliptic channel, delta wave with a cutoff recurrence of 3.5 Hz, theta wave with a cutoff recurrence of 7.5 Hz, alpha wave with a cutoff recurrence of 11.5 Hz, beta with a cutoff recurrence of 30 Hz are removed as appeared in Figure 9.

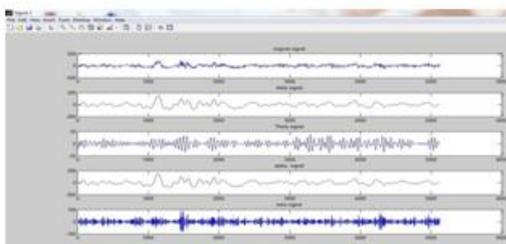


Fig. 9 Filtered image of EEG Data - Amplitude in μ Volts vs Number of Samples

From the removed EEG waves, by applying Fast Fourier Transform (FFT) the intensity of the considerable number of waves is determined. At long last, out of these five channels one channel which has got greatest alpha power is considered for Analysis since Alpha wave is overwhelming when individual is loose.

EEG Amplifier Design of EEG Amplifier and Acquisition of Data using MyDAQ: Biofeedback Application

Two channel EEG Amplifier has been planned and tried for ongoing information procurement of Biofeedback Application. Biofeedback is a system that estimates

Physiological capacities and gives data about them, which thus helps in preparing and controlling the required Physiological capacities. Biofeedback is regularly founded on estimations of Heart rate, Muscle strain, Skin conductivity and Brain waves. By viewing these estimations, one can figure out how to change these capacities by unwinding or by holding lovely pictures or encounters in the psyche. A sound or visual showcase might be utilized to know when an objective or certain state is come to. Biofeedback instructs how to control and change these substantial capacities. Thusly, one can feel progressively loose or increasingly ready to cause explicit muscle unwinding process. This may help treat unfortunate conditions, for example, Anxiety, Insomnia, Constipation, Tension and Migraine cerebral pains. These perceptions help in the plan of Bio criticism framework for self controlling alpha and beta dimension with outer sound or video improvement [14-18]. In this work, Biofeedback is tried for cerebrum waves utilizing the Two-channel EEG Amplifier and MYDAQ System, plan of which is introduced in the following segment.

EEG signal real time Data Acquisition System Design Using MYDAQ and LABVIEW and Results:

In the past segment, it was referenced that FFT is utilized to process the intensity of delta, theta, alpha and beta waves. The square of the genuine piece of FFT coefficient is the power. Before exhibiting the structure of the EEG Data obtaining framework, we have to decipher the impact of Pranayama on subjects. The investigation of intensity varieties would illuminate the unwinding patterns of the subjects. In like manner, the Percentage varieties of alpha power in various locales of the mind among long haul specialists and the transient experts are gained and exhibited in Figure 10 and 11 separately. It might be seen that the Alpha power builds more for long haul specialists than for momentary experts in Right occipital region of the cerebrum, which means that the comparing subjects are in loosened up state. It might along these lines be reasoned that more drawn out the work on affecting the Right occipital region, progressively loosened up the subject will be. It might likewise be noticed that the left mind movement will be higher than the privilege amid sensible reasoning, thinking and so forth. Alpha and beta power may likewise be plotted for subjects so as to discover rate variety in connection to pre-reflection state. In like manner, control plots are exhibited in Figure 12 and 13 for different subjects amid three Pranayama Stages displayed before in Figure 1. Concerning the Temporal setting, toward the finish of the third phase of Pranayama, analyze led on subjects demonstrated that 40% of the subjects have increment in their alpha power, half have increment in alpha power in one phase and 10% no adjustment in alpha power.

Further, 20% of the subjects demonstrated no adjustment in beta power, 30% indicated decline in beta power, 10% have increment in beta power in one cycle, and 40% indicated increment in their beta power.

These are appeared in Figure 12 and 13 individually. Accordingly, we can reason that 40 % of the subjects are loose just as caution amid the Pranayama stages.

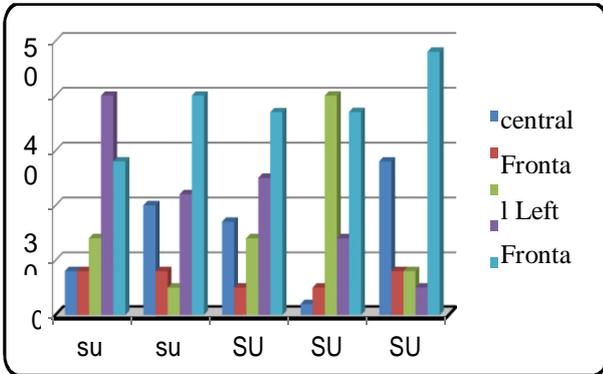


Fig. 10 Alpha Signal Variation Percentage vs Long Term Practitioners

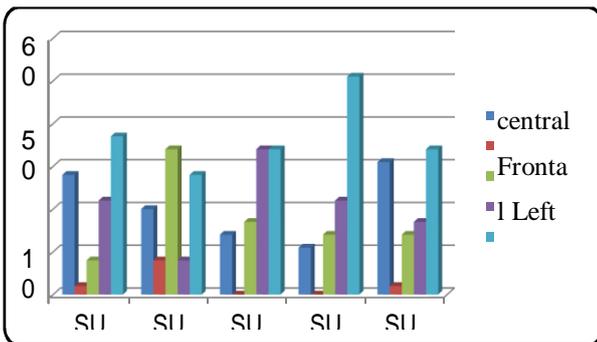


Fig. 11 Alpha signal Variation Percentage vs Short Term Practitioners

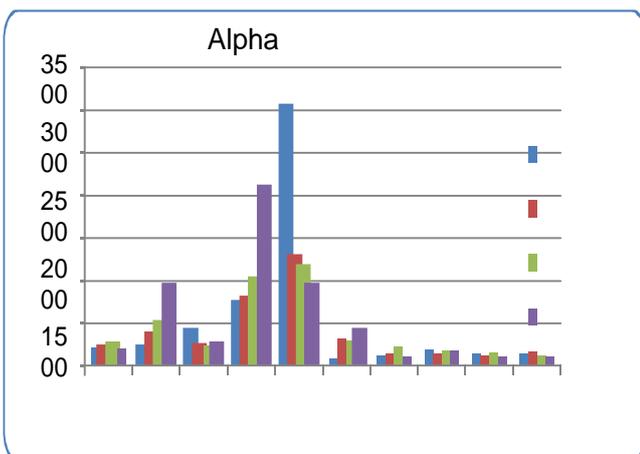


Fig.12 Alpha signal Variation of 10 Subjects During Three Pranayama Stages

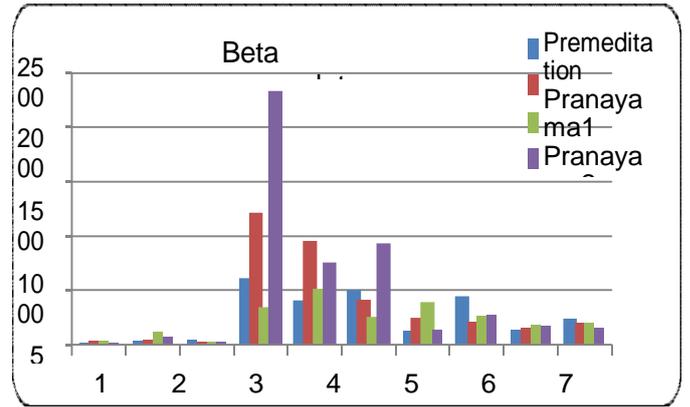


Fig. 13 Beta Signal Variation for 10

Subjects During Three Pranayama Stages



Fig. 14 Two channel EEG Data Acquisition Working Setup Using MYDAQ

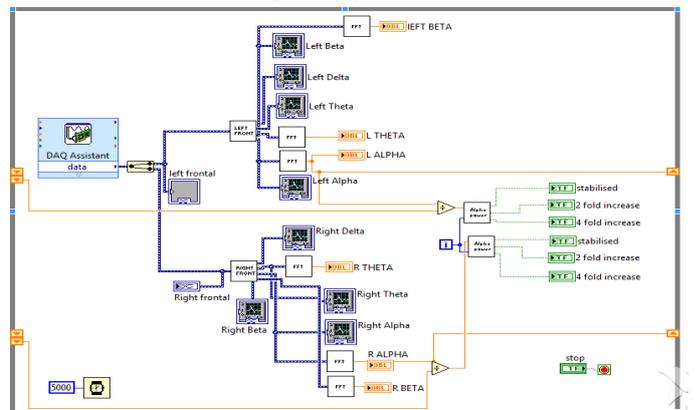


Fig. 15 Results of Two channel EEG Data acquisition System Design Using MYDAQ and LABVIEW

EEG Data procurement setup is appeared in Figure 14, where two or three anodes from the brow of the Subject are sustained to the contribution of the EEG Amplifier, which thus is associated with the MyDAQ of National Instruments.

EEG information is procured from Pre-frontal positions FP3 and FP4. The obtained signs are shown on the Laptop utilizing LabView Design as introduced in Figure 15. Gained EEG Data is gone through second request Butterworth low pass Filter with suitable slice off frequencies to remove alpha, beta, theta and delta waves from the Left and Right Pre-frontal positions. Intensity of Theta, Alpha and Beta for these cathode positions are determined by utilizing FFT. The Threshold esteem is set at half of the gauge EEG of the subject so as to light the pointers, for example, "Balanced out", "2 overlay increment" and "4 overlap increment" ideally. This limit need not be half and can be set as wanted. For a specific intellectual assignment, on the off chance that the power dimension of theta, alpha and beta esteem is consistent, at that point it implies no varieties in the power dimension.

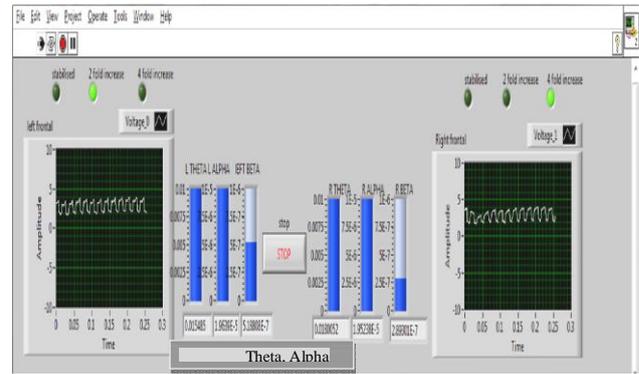


Fig 19 Theta, Alpha, Beta Level after resting eyes

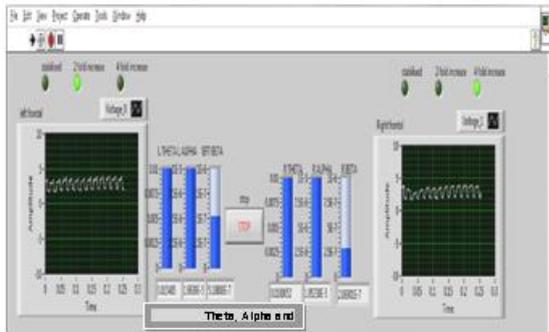


Fig. 16 Theta, Alpha, Beta Level after Performing Meditation

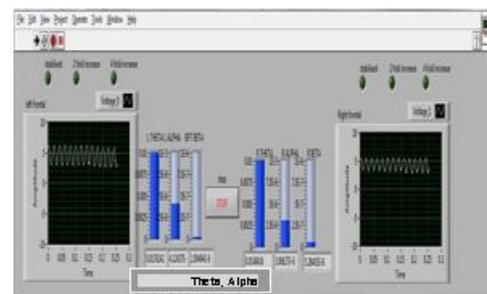


Fig 20 Theta,alpha,beta levels math test opening eyes

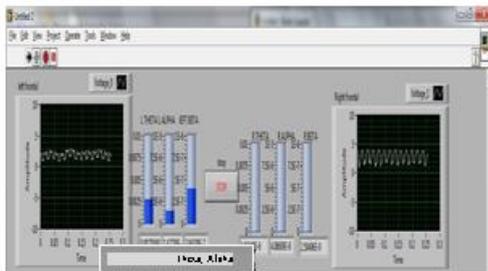


Fig 17 Theta, Alpha, Beta Level after resting eyes

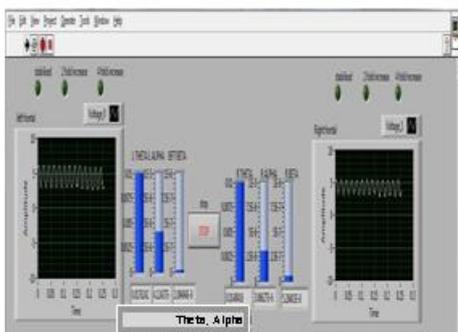


Fig 18 Theta,alpha,beta levels math test opening eyes

CONCLUSION:

Investigation of EEG information amid Pranayama practice demonstrates increment of intensity in delta, theta, alpha and beta waves in long haul professionals to a bigger degree than momentary experts. Spatial Analysis showed higher varieties in the EEG motions in the correct locales of the cerebrum contrasted with the left districts of the mind. The Experimental outcomes plainly demonstrate a larger amount of cognizance experienced amid Pranayama, which turns out to be a standout amongst the best unwinding strategies for intellectual upgrade, which encourages the general population to lead a peaceful life. This paper introduced the structure of EEG Data Acquisition System utilizing MYDAQ and LABVIEW. This pilot think about proposes a biofeedback convention that may be valuable in developing reflective conditions of awareness and giving continuous criticism of upgraded alpha action. There are presently a few standard social insurance programs which help those, both debilitated and sound, in advancing their inward prosperity, particularly care based projects. More Research is required in this area to end up being useful for treatment of patients in Hospitals and restoration focuses.

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