BASIC SIGNAL PROCESSING OF EEG SIGNAL

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Abstract- **EEG signal analysis is such an important thing for disease analysis and brain–computer analysis. Using Electroencephalography (EEG) monitoring the state of the user's brain functioning and treatment for some psychological disorder or dyscalculia, where the difficulty in learning and comprehending the arithmetic exists and it could allow for analysis disease the user to train the corresponding brain. In this paper, we proposed a method for EEG signal processing includes signal de-noising, segmentation of de-noise signal using PCM. Using the Matlab software proposed method accompanied.**

Index Terms- **EEG (Electroencephalography), segmentation, PCM.**

I. INTRODUCTION

For brain signal acquisition various methods used such as electroencephalography (EEG), Functional Magnetic Resonance Imaging (FMRI), Near Infra-Red Spectroscopy (NIRS) and Magneto encephalography (MEG). From this method EEG is wielding used signal acquisition method because of high temporal resolution and safe for use [1]. EEG used in medical purpose and also for brain computer interfacing (BCI). That EEG signal processing important for proper analysis disease. Signal processing of EEG is fundamental for analysis of brain activity and diagnosis of normality or abnormality of signal that is important for analysis of any disease. In this paper devote on EEG signal processing that followed by signal de-noising, segmentation of de-noise signal using "Principal Component Analysis (PCA)" it forms the feature vector. The paper devoted on EEG signal processing, follow by below graph.

EEG data

↓

Signal denoising

↓

Signal segmentation
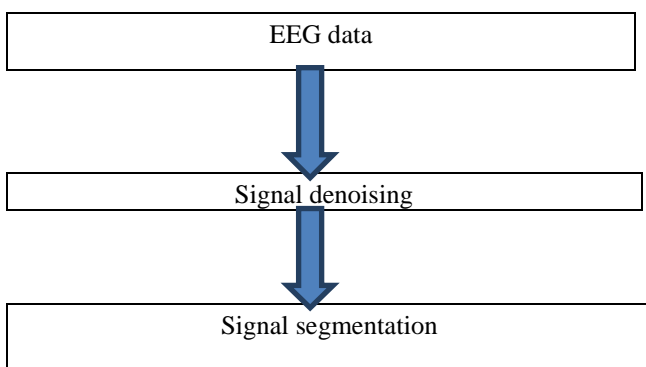
II. SIGNAL DE-NOISING

During EEG recording many of other influence introduce noise which called as artifact. These artifacts come from patient body or instrument, as an example eyes movement, the heart, muscles and line power. Before processing EEG, removal of this artifact is primary task and it form fundamental step for EEG signal processing.

For signal processing of EEG data set taken from online available PhysioNet.

(http://physionet.org/physiobank/database/chbmit)

EEG signal de-noising can be done by both wavelet and time domain method. Here we used Low pass filter for de-noising. Most of time EEG signal contain neural information below 100 Hz so it's beneficial to use low pass filter.

Low pass filter implementation carried thrown matlab which will allow removing noise and artifact from the original signal extracted from patient [2].

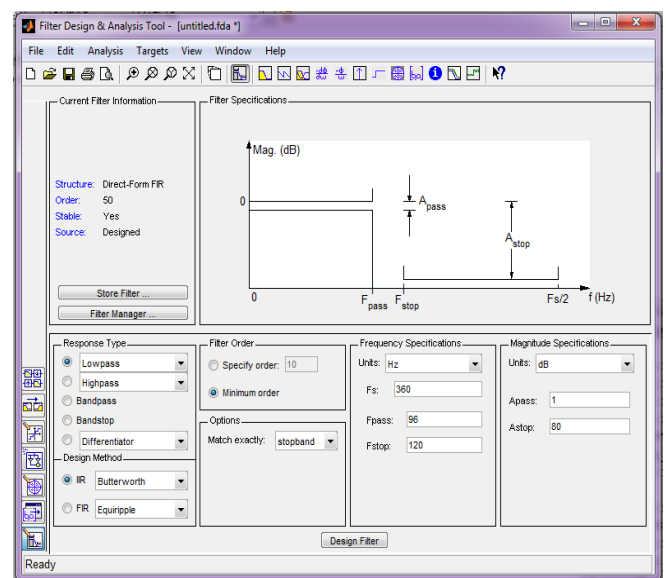Using filter design and process Low pass filter is implemented as shown below figure.

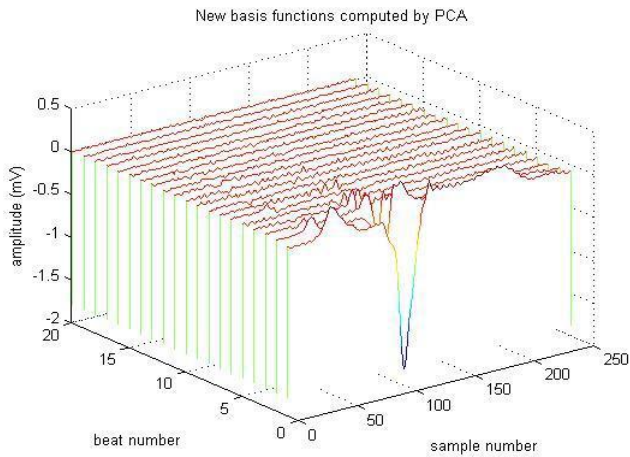
Fig.1: Lowpass filter implementation

After design filter implemented filter apply to EEG signal, then result shown as follows.

Fig 2: Original signal

Fig 3: Denoise signal

III. SIGNAL SEGMENTATION USING PCM

Segmentation of EEG signals should be performed over all channels. In most cases it is important to extract information present in all parallel time series at first. The principal component analysis good for this type requirement and large data set, it took a large set of data and identified an optimal new basis in which to re-express the data [3].

Assume that we start with a data set that is represented in terms of an m × n matrix, X where the n columns are the samples (e.g. observations) and the m rows are the variables. We wish to linearly transform this matrix, X into another matrix, Y, also of dimension m × n, so that for some m × m matrix, P,

$$Y = PX$$

This equation represents a change of basis. If we consider the row vector P to be the row vectors p1, p2, . . . , pm, and the columns of X to be the column vectors x1, x2, . . . , xn, then can be interpreted in the following way.

$$PX = (Px_1 \, Px_2 \ldots Px_n)$$

$$= \begin{bmatrix} p1.\,x1, p1.\,x2 \ldots \ldots .\, p1.\,xn \\ p2.\,x1, p2.\,x2 \ldots \ldots .\, p2.\,xn \\ ::::: \qquad\qquad ::::::::: \\ pm.\,x1, pm.\,x2 \ldots \ldots \ldots pm.\,xn \end{bmatrix}$$

Note that pi, x_j implies from R_{Ym}, and so $p_i.x_j$ is just the standard Euclidean inner (dot) product. This tells us that the original data, X is being projected onto the columns of P. Thus, the rows of P, {p1, p2. pm} are a new basis for representing the columns of X.

The rows of P will later become our principal component directions [4].

Principal component analysis defines independence by considering the variance of the data in the original basis. This is shown in fig.5 below. It forms a feature vector for further signal processing.

Fig.4: first principal component

Fig.5: New basic function by PCM

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