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Wearable, EEG-based Massage Headband for Anxiety Level Detection and Relaxation

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ABSTRACT

Anxiety is becoming a severe issue in most of the cases. Anxiety monitoring system by analyse the Electroencephalography (EEG) signals and software, these signals are captured by a multichannel electrode system. The actual EEG signals are subjected to band pass filtering with cut-off frequencies 0.5Hz and 100Hz.Before that unwanted noise eliminated by subtracting the noisy signal from original EEG signal. The filtered signals are analyzed using time-frequency technique known as discrete wavelet transform. The third-order Debauchies wavelet and level of decomposition is utilized to segregate the signals into sub-bands. The features serve as an input to the next stage system classification of a neural network. In this work, based on the neurological data obtained from the database, the persons state of mind can be identified. A motor circuit functioning on an Arduino driven platform is built and interfaced with MATLAB. It gets activated when the Anxiety levels reach higher level.

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Keywords - Electroencephalography , Arduino, Signal processing,Artificial Neural Networks(ANN).

I. INTRODUCTION

Electroencephalography (EEG) is a non-invasive procedure well-known for its seamless acquisition of neural signals with the aid of skin electrodes placed on various regions of human brain. The multi and the single channel recording modes promoted an easy way of attaining brain signals. The signals upon transmission to a computer facilitated an easy analysis of brain waves for diagnostic. In the diagnostic front of the EEG applications, the increase in beta level activity of the high stressed subjects by obtaining their EEG signals from a single channel EEG headset. The biofeedback methods for mollifying mental disorders, built a mobile platform that can play an appropriate music track based on the subject's state of emotion at the moment of the test. The biofeedback helps to improve musical performance in musicians. EEG devices developed in the past, adopting the multi-channel mode of recording, have contributed to more device weight. This is becoming wearisome to both the subjects and technicians resulting in the rise of device set-up time. Additionally, devices with electrodes more than fifty-two (52) in number contributed to a rise in signal noise with a considerable loss in potential EEG signal information.

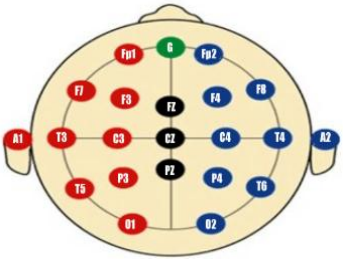

Fig. 1 Electrode placement in 10-20 EEG international system

II. DESIGN METHOD

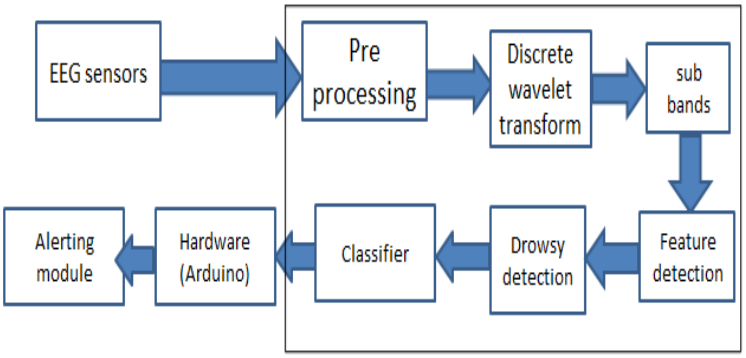

Fig.2Signal Processing Block

PRE PROCESSOR

The filter whose input response is of any finite length of finite duration, as it comes down to zero in finite time is called as finite impulse response (FIR) filter , is used in signal processing. FIR filters in contrast to IIR filters, have internal feedback continues to respond indefinitely. Before, impulse response comes to zero, the discrete time FIR filter of Nth order lasts for N+1 samples. Inthis stage, Noise removal and interpolation takes place.

DISCRETE WAVELET TRANSFORM

The wavelet transform have particular strengths which lie in its noise and data reduction abilities, used for practical applications. In other aspects, it have led to increase the interest of engineers in non-destructive testing (NDT(. These applications of wavelet transform vary from de-noising to the dispersion curves for multimode lamb waves. This stage helps signal to decompose into spatially distributed frequency components which is selectively filtered based on required application.

FEATURE EXTRACTION AND ANXIETY DETECTION

The human brain consists of billions of neurons, made up nerve cells. These neurons have high complex firing patterns, in complicated fashion. The oscillations of neurons can be measured using EEG. The measured signals are directly visible to human eye, which is raw, unfiltered and unprocessed data. A mixture of several

underlying base frequencies is called as signal. These signals are considered to reflect at certain cognitive, affective or attention states, as they slightly vary dependent on various individual factors, there stimulus properties and internal states. These frequencies can be classified based on there specific frequencies namely: Delta band (1 – 4 Hz), theta band (4 – 8 Hz), alpha band (8 – 12 Hz), beta band (13 – 25 Hz) and gamma band (> 25 Hz).

STAGE	FREQUENCY (HZ)	AMPLITUDE (MICRO VOLTS)	TYPES OF WAVEFORM
1	4 - 8	50-100	Theta
2	4-15	50-150	Spindle waves
3	2-4	100-150	Spindle waves and slow waves
4	0.5-2	100-200	Slow wave and delta waves

TAB1: Frequency Ranges

Delta band (1 - 4 Hz)

The oscillations of the delta waves are characterised in the range of 1-4Hz, since the slowest and highest amplitude brainwaves which are present only during non-REM sleep or slow wave sleep .

Theta band (4 - 8 Hz)

Theta band is defined based on the oscillations of the brain waves at the range of 4-8 Hz. According to studies, theta activity at the frontal lobes correlate the difficulty of mental operations , ex: during processing and learning or memory recall .

Alpha band (8 - 12 Hz)

The rhythmic oscillatory activity at the range of 8-12 Hz is reffered as alpha band . They can be found at posterior cortical sites, including occipital, parietal and posterior temporal regions of brain. The increased levels of alpha band can be observed during physical and mental relaxation by closing eyes.

Beta band (12- 25 Hz)

The oscillations at the range of 12-25 Hz is usually called as beta band activity. The beta band frequency can be obtained by capturing the brain waves from both the posterior and frontal regions. The high beta power can be observed when the person is active ,busy or anxious.

Gamma band(above 25hz)

It is defined when the frequency is above 25Hz. As, it is not clear from where the gamma frequencies can be obtained and what they reflect, they are considered as black holes of EEG research. According to observations,

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it is seen that gamma band is as same as theta band reflects the attention process, as they serve as carrier frequency for binding the various sensory impressions.

CLASSIFICATION

The network which consists of units called neurons arranged in the form of layers which converts an input vector to some output is called a neural network. Each neuron unit takes an input, processes a non-linear function to it and then it passes the output on to the next layer .

Supervised Learning is the best example for ANN classification. To know whether the system is performing properly or not, Known Class Labels are used.

I. RESULTS

It is proposed the sub bands obtained from discrete wavelet transform for an awake person in time domain and frequency domain.

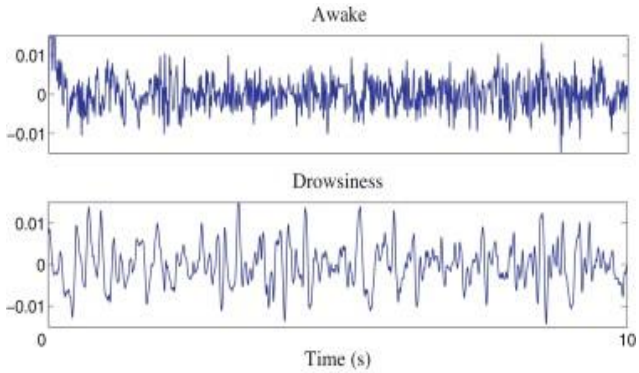

Fig. 3 EEG signal for an awake and anxiety stage.

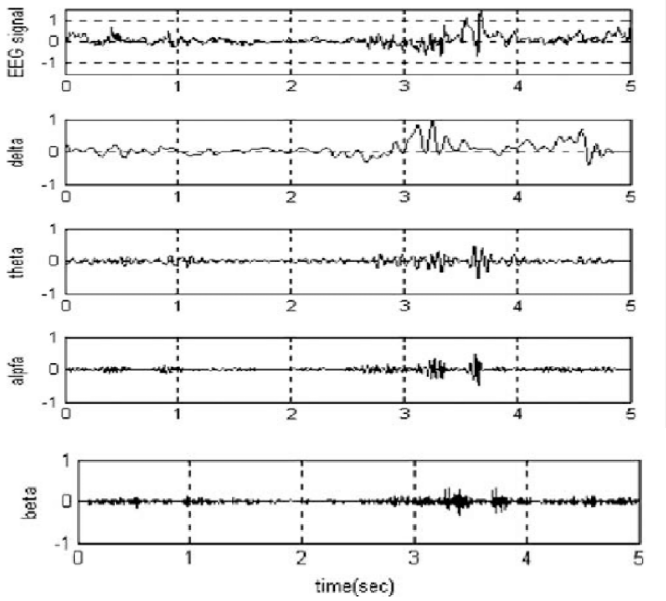

Fig. 3a. EEG signal and its sub bands obtained from wavelet transform for an awake person in time domain.

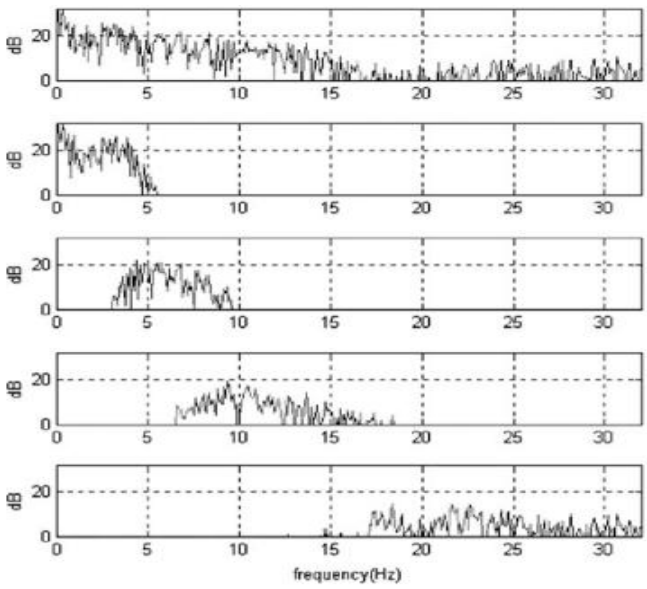

Fig. 3b. Frequency components of EEG signal and its sub bands.

V. CONCLUSION

In this paper various techniques have been discussed for detecting and classifying the EEG signal. Hence artificial neural network algorithms are one of the ways to detect various signals and can helpful to a anxiety detection. Most of the methods include pre-processing followed by feature extraction for awake and anxiety detection.

For the diagnosis of drowsiness, EEG is an important component, identified by epileptiform discharge. The present works aim at classifying the EEG pattern into two groups (awake and anxiety), based on the area of the frequency spectrum under different sub-bands. After feature extraction, the classification of the patterns based on the frequency spectrum features is carried out using a neural network. The network based on the back-propagation algorithm is able to achieve an accuracy of 80%. The algorithm is found to be highly sensitive to initial weight and network structure.

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