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| Title | inference | Date | Journal |
| A Real-Time Model Based Support Vector Machine for Emotion  Recognition Through EEG | * Applications: in market survey or neuro-marketing. * emotion recognition model based on the Russell’s circumplex model, Higuchi Fractal Dimension (HFD) algorithm and Support Vector Machine (SVM) as a classifier * In a first approach, machine learning was utilized for all EEG signals from numerous subjects while another used machine learning for each particular subject. * The experimental results showed that the first approach is impossible to apply in practical applications because EEG signal of each subject has individual characteristic. * In addition, in the second, our model can recognize five basic states of human emotion in real-time with average accuracy 70.5%. | 2012 | 2012 International Conference on Control, Automation and Information Sciences |
| Feature Extraction and Selection  for Emotion Recognition from EEG | * Many methods for feature extraction have been studied and the selection of both appropriate features and electrode locations is usually based on neuro-scientific findings * Review feature extraction methods for emotion recognition from EEG based on 33 studies. (Not DEAP) * An experiment is conducted comparing these features using machine learning techniques for feature selection on a self-recorded data set. * Results are presented with respect to performance of different feature selection methods, usage of selected feature types, and selection of electrode locations. * Features selected by multivariate methods slightly outperform univariate methods. * Advanced feature extraction methods such as HOC, HOS, and HHS were found to outperform commonly used spectral power bands. * Results also suggest preference to locations over parietal and centro-parietal lobes. | 2014 | IEEE Transactions on Affective Computing |
| EEG based Emotion Recognition using SVM and  PSO | * Classify human emotions using EEG signals into four discrete states, namely happy, sad, angry and relaxed (Russell’s circumplex model). * The pre-processed signals from the DEAP database is used and spectral and statistical features are extracted by discrete wavelet transform. * These features are classified using a SVM classifier and the performance of the classifier is optimized using the PSO algorithm. * An overall emotional accuracy of 80.625% was obtained for a combination of 32 electrodes with a valence and arousal accuracy of 86.25% and 88.125%. * A good classification accuracy of 70.625% was obtained using a reduced set of 5 electrodes P7, P3, PZ, T7 and T8. | 2017 | EEG based Emotion Recognition using SVM and  PSO |
| Discrete Wavelet Transform Coefficients for Emotion Recognition  from EEG Signals | * Used DWT coefficients as features for emotion recognition from EEG signals. * Previous feature extraction methods used power spectra density values derived from Fourier Transform or sub-band energy and entropy derived from Wavelet Transform. These feature extraction methods eliminate temporal information which are essential for analysing EEG signals. * The DWT coefficients represent the degree of correlation between the analysed signal and the wavelet function at different instances of time; therefore, DWT coefficients contain temporal information of the analysed signal * Also study the effects of using different wavelet functions (Coiflets, Daubechies and Symlets) on the performance of the emotion recognition system. * The input EEG signals were obtained from two electrodes according to 10-20 system: Fp1 and Fp2. * Visual stimuli from International Affective Picture System (IAPS) were used to induce two emotions: happy and sad. Two classifiers were used: Extreme Learning Machine (ELM) and Support Vector Machine (SVM). * Experimental results confirmed that the proposed DWT coefficients method showed improvement of performance compared to previous methods. * The proposed method also showed the best average performance of 84.67%. | 2012 | 34th Annual International Conference of the IEEE EMBS |
| DEEP LEARNINIG OF EEG SIGNALS FOR EMOTION RECOGNITION | * Proposed a deep learning algorithm to simultaneously learn the features and classify the emotions of EEG signals. * It differs from the conventional methods as we apply deep learning on the raw signal without explicit hand-crafted feature extraction. * Because the EEG signal has subject dependency, it is better to train the emotion model subject-wise, while there is not much epochs available for each subject. Deep learning algorithm provides a solution with a pre-training way using three layers of restricted Boltzmann machines (RBMs). * Thus, we can use epochs of all subjects to pre-training the deep network, and use backpropagation to fine tuning the network subject by subject. * Experiment results show that our proposed framework achieves better recognition accuracy than conventional algorithms. | 2015 | IEEE International Conference on Multimedia & Expo Workshops (ICMEW) |
| DEEP LEARNINIG OF EEG SIGNALS FOR EMOTION RECOGNITION | * A publicly available dataset from eNTERFACE Workshop 2006 was used having as stimuli emotionally evocative images. * At first, EEG features were extracted based on literature review. Then by performing feature selection and classification into two at a time emotional states. * The analysis presented, showed that the best classification scheme achieved accuracies of 75.59%, 75.06% and 75.12% for the three pairs of classes clam/exciting negative (C-EN), calm/exciting positive (CEP), exciting positive/exciting negative (EP-EN) respectively. * . Besides, the analysis showed that the better discrimination is apparent in occipital (O1, O2) and parietal (P3, P7) channels. This can be partially attributed to the fact that this experiment involved the use of visual stimuli. * Applications: music therapy dealing with pain management or depression, supporting facially paralyzed patients on expressing their emotions, facilitating the health care of persons with communicative disorders, monitoring surgeons' stress levels during an operation, or as an extension to self-monitoring systems. |  |  |
| Emotion Stress Detection using EEG Signal and Deep Learning Technologies | * Proposed music frequency to detect emotion stress using brainwave and utilize deep learning. * From experiment, our model could predict until 80% for test subject’s mental states. Our model has small MSE loss to 0.0882, it means our error will be smaller, and our validation loss is almost the same as our model training loss which means our model doesn’t face over-fitting. | 2018 | IEEE International Conference on Applied System Innovation |
| Classification of emotions induced by music videos and correlation with participants’ rating | * Emotion recognition induced by music videos. * SVD–QRcp and F-Ratio based feature selection method is employed for eliminating weak and redundant features. * With these features the average classification rates are 65.3% for valance, 66.9% for arousal, 71.2% for like and 69.1% for dominance. * Different electrodes of different brain regions are selected for valance, arousal, liking and dominance. * Energy features representing asymmetry between the right and left hemisphere of brain are prominent in valance and arousal classification as compared to liking and dominance. * Temporal lobe is involved in arousal classification. * Different sub bands play significant role in different brain regions. In addition to this, we explored how DT-CWPT sub bands and brain regions are activated by different emotional states. * Valance and liking shows strongest correlation in all analysed sub bands. Whereas, there is significant correlation in parietal and occipital brain regions related to high-beta and gamma sub bands for all: valance, arousal, liking and dominance. * An opposite correlation patterns in 4–8 Hz and 8–12 Hz sub bands is also noticed for arousal and liking. | 2014 | Expert Systems with Applications, Elsevier |