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| --- | --- | --- | --- |
| **Paper** | **Features** | **Algorithms** | **Ref. Index** |
| Lin, Yuan-Pin, Chi-Hong Wang, Tzyy-Ping Jung, Tien-Lin Wu, Shyh-Kang Jeng, Jeng-Ren Duann, and Jyh-Horng Chen. "EEG-based emotion recognition in music listening." *IEEE Transactions on Biomedical Engineering* 57, no. 7 (2010): 1798-1806. | * Power Spectrum Density * Differential Asymmetry * Rational Asymmetry * Feature extracted based on F-Score | * SVM * Multi-layer Perceptron | **6** |
| Peng, Yong, Jia-Yi Zhu, Wei-Long Zheng, and Bao-Liang Lu. "EEG-based emotion recognition with manifold regularized extreme learning machine." In *2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 974-977. IEEE, 2014. | * Average alpha, beta, gamma, delta, theta power on each channel(62 channels) | * SVM * GELM * MRELM | **7** |
| Aboalayon, Khald AI, Wafaa S. Almuhammadi, and Miad Faezipour. "A comparison of different machine learning algorithms using single channel EEG signal for classifying human sleep stages." In *2015 Long Island Systems, Applications and Technology*, pp. 1-6. IEEE, 2015. | * Energy * Entropy * Standard Deviation | * SVM * DT * KNN * NN * NB | **1** |
| Jalilifard, Amir, Ednaldo Brigante Pizzolato, and Md Kafiul Islam. "Emotion classification using single-channel scalp-EEG recording." In *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp. 845-849. IEEE, 2016. | Spectral Power of -   * Alpha * Beta * Delta * Gamma * Theta * All(Average of all) | * SVM * KNN   (considered artifactual and artifact free data) | **2** |
| Ammar, Sabrina, and Mohamed Senouci. "Seizure detection with single-channel EEG using Extreme Learning Machine." In *2016 17th International Conference on Sciences and Techniques of Automatic Control and Computer Engineering (STA)*, pp. 776-779. IEEE, 2016. | |  |  |  | | --- | --- | --- | | **Features name** | **Description** | | | Mean | The mean value describes the location of the distribution | | NCOV | ratio of variance | | Std | Standard deviation | | skewness | Describes the trend of the probability distribution function of a signal. | | Kurtosis | Describes the trend of the probability distribution function of a signal. | | Mean DSP | The mean value of DSP | | Peak\_PSD | Peak Frequencies | | * NN(ELM)   94.85% in average | **-** |
| Jiang, Yizhang, Dongrui Wu, Zhaohong Deng, Pengjiang Qian, Jun Wang, Guanjin Wang, Fu-Lai Chung, Kup-Sze Choi, and Shitong Wang. "Seizure classification from EEG signals using transfer learning, semi-supervised learning and TSK fuzzy system." *IEEE Transactions on Neural Systems and Rehabilitation Engineering* 25, no. 12 (2017): 2270-2284. | * Wavelet Decomposition Features * Short Time Fourier Transform Features | * TSK Fuzzy model compared with SVM, NN, DT, S4VM, LMPROJ etc. | **-** |
| Dhivya, S., and A. Nithya. "A Review on Machine Learning Algorithm for EEG Signal Analysis." In *2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA)*, pp. 54-57. IEEE, 2018. | * Alpha * Beta * Gamma   Spectral Power of the bands | * SVM * ANN * K-Means * XGBoost | **8** |
| Liao, Chung-Yen, and Rung-Ching Chen. "Using Eeg Brainwaves And Deep Learning Method For Learning Status Classification." In *2018 International Conference on Machine Learning and Cybernetics (ICMLC)*, vol. 2, pp. 527-532. IEEE, 2018. | * Alpha * Beta * Gamma * Delta * Theta   Spectral Power of the bands | * Deep Learning Architecture with ReLU activation function. | **12** |
| Wu, Yu-Te, Tzu Hsuan Huang, Chun Yi Lin, Sheng Jia Tsai, and Po-Shan Wang. "Classification of eeg motor imagery using support vector machine and convolutional neural network." In *2018 International Automatic Control Conference (CACS)*, pp. 1-4. IEEE, 2018. | Spectral Power of –   * Alpha * Beta * Theta * Gamma * Delta Bands   Ratio of Beta power to Alpha power, ratio of alpha+beta to theta+delta | * SVM * CNN(.613) | **-** |
| C.Jaganathan, A.Amudhavalli, T.Janani, M. Dhanalakshmi, Nirmala Madian. “Automated algorithm for extracting α, β, δ, θ of a human EEG.” In *2015 International Journal of Science, Engineering and Technology Research (IJSETR) (Vol. 4, Issue 4)* | Raw EEG broken down to alpha, beta, theta, gamma, delta. | * BUTTERWORTH FILTER * FFT | **3** |
| Bhardwaj, Rahul, Swathy Parameswaran, and Venkatesh Balasubramanian. "Performance Comparison of Machine Learning and Deep Learning While Classifying Driver’s Cognitive State." In *2018 IEEE 13th International Conference on Industrial and Information Systems (ICIIS)*, pp. 89-93. IEEE, 2018. | * Alpha * Beta * Gamma * Delta * Theta   Relative power of these | * KNN * SVM * DT * Ensemble * Autoencoder(Deep Learning | **9** |
| Deng, Yaling, Fan Wu, Lei Du, Renlai Zhou, and Lihong Cao. "EEG-Based Identification of Latent Emotional Disorder Using the Machine Learning Approach." In *2019 IEEE 3rd Information Technology, Networking, Electronic and Automation Control Conference (ITNEC)*, pp. 2642-2648. IEEE, 2019. | * Alpha * Beta * Theta * Delta   Power of these bands. | * SVM(5 fold cross validation) | **-** |
| Jeevan, Reddy Koya, SP Venu Madhava Rao, Pothunoori Shiva Kumar, and Malyala Srivikas. "EEG-based emotion recognition using LSTM-RNN machine learning algorithm." In *2019 1st International Conference on Innovations in Information and Communication Technology (ICIICT)*, pp. 1-4. IEEE, 2019. | Similar Features. | * LSTM\_RNN | **4** |
| Ieracitano, Cosimo, Nadia Mammone, Alessia Bramanti, Silvia Marino, Amir Hussain, and Francesco Carlo Morabito. "A Time-Frequency based Machine Learning System for Brain States Classification via EEG Signal Processing." In *2019 International Joint Conference on Neural Networks (IJCNN)*, pp. 1-8. IEEE, 2019. | * Mean * SD * Skewness * Kurtosis etc.   Of Alpha, beta, Gamma, Delta, Theta bands. | * Autoencoder * Multilayer Perceptron * SVM * Logistic Regression   To classify Alzeihmer’s Disease, Mild Cognitive Impairment and Healthy Control mental states. | **5** |
| Kher, Rahul K., and Rathang U. Shah. "Wireless EEG Signal Acquisition and Device Control." In *researchgate.com(2016)* | Bluetooth mechanism to capture wireless EEG signal | * Muse2 * Bitalino * Brainsense * Neurosky   These are the devices that could be used to do this. | **14** |
| Amin, Hafeez Ullah, Wajid Mumtaz, Ahmad Rauf Subhani, Mohamad Naufal Mohamad Saad, and Aamir Saeed Malik. "Classification of EEG signals based on pattern recognition approach." *Frontiers in computational neuroscience* 11 (2017): 103. |  |  | **10** |
| Bashivan, Pouya, Irina Rish, Mohammed Yeasin, and Noel Codella. "Learning representations from EEG with deep recurrent-convolutional neural networks." *arXiv preprint arXiv:1511.06448* (2015). |  |  | **11** |
| Subasi, Abdulhamit. "EEG signal classification using wavelet feature extraction and a mixture of expert model." *Expert Systems with Applications* 32, no. 4 (2007): 1084-1093. |  |  | **13** |
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Butter-worth Filtering for Noise Removal

FFT Algorithm

Generating α, β, δ, θSub-Bands

**Raw EEG**

**Input**

StudentN

EEG set

Student4

EEG set

Student3EEG set

Student2

EEG set

Student1

EEG set

**…………**

**Capture EEG**

Teacher with workstation

**start**

**Separate raw EEG signals as data streams**

**Feed Decomposed Signals Final Output**

**Of CALR system**

**Feed Features**

Individual Human Attention Level Recognition System

Feature Extraction for N data streams