Summary Table of 52 Research Articles

Ref.	Publishing year	Depression Type	Total Participant (Healthy / Affected)	Questionarrie Assessment	EEG Device (number of Electrodes)	Artifacts Removal	Classification Method	Frequency Band	Classification Result			Remarks
									Accuracy (%)	Sensitivity (%)	Specificity (%)	
[24]	2020	MDD	39 (19 / 20)	HRSD, HAMA, MMSE	Neuroscan Quik-cap (64)	EOG by ICA; 50Hz artifacts by STFT	*SVM* , DT, GMM, NB, KNN, RF	*Beta* , Delta	89.7	89.4	89.9	Decreased connectivity pattern in delta band and increased connectivity pattern have observed during music perception within MDD patients.
[72]	2019	depression by stress	27 (- /27)	STAI	Muse Headband (4)	Built-in Proprocessing Mechanism	SMO, SGD, *LR* , MLP	Alpha, Beta, Theta, Delta, Gamma	98.7654	–	–	Boxplot variants and median score differences are more noticeable among females than males while listening to music. Patients have been highly influenced according to the different languages of the music track.
[54]	2018	Depression	26 (13 / 13)	EST-Q	NeuroScan Synamps2 (30)	BandPass filter	LR with LOO cross validation	*Alpha* , Theta, Beta, Gamma	92 (Maximal)	–	–	The classification model highly over fitted with the single channel electrode than multi-channel EEG. Highest classification accuracy achieved with the mixed combination of the linear and non-linear measures.
[55]	2020	Depression	178 (92 / 86)	MINI, PHQ-9, PSQI, CTQ, EPQ, LES	Pervasive EEG (3)	50Hz Notch for 50Hz freq. signal, Blackman Time window	*KNN* , SVM, DT	Theta, Alpha, Beta, Gamma	86.98	–	–	The Maximum accuracy (86.98%) has been observed in KNN Classifier with the three frontal regional electrodes using modality fusion of positive and negative audio stimuli.

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[38]	2015	MDD	30 (15 / 15)	HAM-D	BrainProducts (16)	0.5-50Hz bandpass filter	ANN, *PNN* , (KNN, LDA, LR), staistical analysis (ANOVA)	Beta, Gamma	99.5	–	–	During the noise period, patient's brain higher complexity value demonstrated negative emotional bias from the frontal and parietal brain regions.
[39]	2021	MDD	64 (30 / 34)	DSM-IV	BrainMaster (19)	DWT, WT, WPT, EMD, EMD-DWT, EMD-WPT, VMD, DFA	*RF* , SVM	Alpha	99.97	–	–	To minimize the mode-mixing as well as better denoising of EEG features, two fusion methods i.e. VMD-DFA-DWT and VMD-DFA-WPT proposed; of them VMD-DWT-WPT shows higher accuracy with RF.
[106]	2020	depression	45 (24/21)	BDI	scalp electrode (64)	ICA	CNN-2LSTM-Dense, CNN-3LSTM-Dense, 4LSTM-2Dense, CNN-2LSTM-3Dense (DepHNN)	Alpha, *Theta*	99.1			DepHNN performed with 64x5 convolutional layer, 2 LSTM layer and 3 dense layer, which confirms classification results improve with increasing the number of Kernel size.

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[56]	2019	Depression	28 (14 / 14)	MINI, DSM-IV	128-channel HydroCel Geodesic Sensor Net (HCGSN) (16)	Adaptive noise canceller based on LMS, 0.5–40 Hz band-pass filter for EMG, FastICA	*SVM* , RF, KNN, 7-layer CNN, 8-layer CNN(with Adam Algorithm)	*Alpha* , Beta, Theta	87.06	_	_	Significant result found using power spectral density and ensemble learning model where a deep forest transformed the original features to new features.
[88]	2019	MDD	63 (30 / 33)	DSM-IV, BDI-II, HADS	- (19)	MSEC with BESA software	*1DCNN* , 1DCNN with LSTM both for eye open and eye close	_	98.32	_	_	Due to using more study samples, this study reported higher accuracy (95.97%) and fair account on the deep learning architecture (1DCNN-LSTM Classification)
[64]	2013	Depression	90 (45 / 45)	DSM-IV, BDI	- (19)	Highpass filter with 0.5 Hz, lowpass filter with 70 Hz, Notch filter	KNN, LDA, *LR*	*Alpha* , Beta, Delta, Theta	90 (all nonlinear features)	_	_	Combining non-linear features, the LR classification model reported the highest performance of distinguishing the control and depressed subjects.
[58]	2017	Depression	30 (15/15)		2-channel EEG	notch filter, Z-normalization	CNN		93.54 (left) 95.49 (right)	91.89 (left) 94.99 (right)	95.18 (left) 96.00 (right)	13-layer deep CNN model has been proposed which is time consuming and needs powerful hardware.

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[110]	2012	MDD	24 (12 / 12)	_	19-channel EEG device (7)		EPNN	Alpha, *Beta* , Theta, Delta, Gamma	91.3	_	_	EPNN with the wavelet-chaos methodology and Fractality Dimension (FD) as a measure of nonlinearity, yielded a high accuracy of 91.3% for diagnosing of the MDD patients.
[59]	2018	Depression	16 (- / 16)	PHQ-9	BrainMarker , model: DEV12001E EG (19)	Eye blink Removal and basic filter using QExG software	HOC for emotion; SVM, KNN, SSD, classifer Tree	Alpha, Beta	71	_	_	This study focuses on the depression presence along with the suicidal ideation with the stimuli while subjects were given to read suicidal notes and indicates that beta waves were more responsible as they relate with the memory.
[42]	2020	MDD	64 (30 / 34)	DSM-IV	- (19)	BandPass filter, 50Hz Notch filter,	LR, MLPNN, RBFN, SVM, *MDCNN*	Alpha, *Beta* , Theta, Delta, *low Gamma*	97.27	97.27	97.35	Multilayer deep CNN model has been designed with different frequency bands where beta and low-gamma shows significant results of identifying MDD patients.
[60]	2020	Depression	43 (20 / 23)	_	NicoletOne Digital EEG Amplifier (19)	Nihon Kohden apparatus	*MLP* , LR, SVM, MP, DT, RF, NB	*Alpha* , Beta, Theta	100	_	_	This study illustrated the effectiveness of two non-linear measures- HFD and SampEn for seven machine learning approaches and shows better distinguishable performance with the SampEn non-linear features.

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[43]	2020	MDD	64 (30 / 34)	DSM-IV	- (19)	50Hz Notch filter, band-pass filter with cutoff frequencies at 0.1 Hz and 70 Hz	1DCNN, 2DCNN, LSTM, *1DCNN-LSTM*, 2DCNN-LSTM	delta, theta, alpha or mu, beta1, beta2, beta3, beta, gamma	99.245	98.519	100	Among five different deep learning architecture models, 1 dimensional CNN combined with LSTM model results higher accuracy and better brain connectivity of spatial and temporal relations.
[44]	2020	MDD	64 (30 / 34)	Public Collected Data	- (19)	50Hz Notch filter, band-pass filter with cutoff frequencies at 0.1 Hz and 70 Hz	SVM, MLP, *EKNN*	Alpha, Beta, Theta, Delta, *Gamma*	98.44	97.1	100	This experimentation demonstrated the E-KNN as a high distinguishable classifier and combines power and complexities of high frequency components based on short term EEG; the highest accuracy obtained from EEG Linear features with gamma band power.
[45]	2020	Clinical Depression		_	Synamps2 system (64)	Bandpass Filter (0.5-100), FASTER algorithm and ICA for eye blinks, Z-score normalizatio n	13-layered CNN-LSTM	Alpha, Beta, Delta, Theta	99.07 (Right); 98.84 (Left)	99.5 (Right); 98.61 (Left)	98.60 (Right); 99.06 (Left	Essential feature extraction using CNN and the sequence learning by LSTM performs as better diagnostic model and found high performance of right hemisphere compared to left hemisphere for MDD patients.

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[61]	2019	Depression	30 (15 / 15)	_	- (4)	50Hz Notch Filter	CNN-LSTM (left and right)	_	99.12 (Right); 97.66 (Left)	98.55 (Right); 97.03 (Left)	99.7 (Right); 98,27 (Left)	For the presence of deep learning long term dependencies, LSTM model has been combined with CNN model and achieved higher accuracy for the right hemisphere of MDD patients.
[62]	2018	Depression	265 (113 / 152)	_	- (3)	Bandpass filter based on Blackman time window, Kalman Filter	SVM, KNN, *DT* , LR, RF	Alpha, Beta, Theta, Delta, Gamma	76.4	_	_	Among four different feature selection processes with five classifier, WrapperSubsetEval of the wrapper class for DT classifier shows high performance of discriminating healthy and depressed groups.
[36]	2019	Mild Depression	51 (27 / 24)	BDI-II	HydroCel Geodesic Sensor Net (HCGSN) (128)	Net Station Waveform Tools, FastICA for ocular artifacts	*CNNB* , BN, SVM, LR, KNN, RF	Alpha, Beta, Theta	84.13	_	_	Along with the computer-aided of CNN model study, this experimentation focuses on the spectral, spatial and temporal information of EEG signals and found that spectral and temporal information plays major roles for discriminating the mild depressed patients.

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[111]	2018	Depression	34 (17 / 17)	MINI, PHQ-9	128-channel HydroCel GSN (3)	FastICA for OC	CNN, Maxpooling, Temporal Convolution, LSTM	Alpha, Beta, Theta	77.2	–	–	CNN achieved highest classification accuracy of 77.20% by the non-distance projection method and 76.14% by the distance-based projection method.
[73]	2019	Depression due to PTSD	19 (- / 19)	Russell's Circumplex Model of Affect	Emotiv EPOC+ (14)	AuBT, 3rd order Butterworth	*KNN* , SVM-RBF, DT, LDA	Theta, low alpha, beta, gamma	78.27	–	–	This study found the emotional states of depressed human while they were interacting with the horses; in that cases three EEG, ECG and EMG signal of subjects have been recorded and machine learning techniques were used to to distinguish their mapped positive and negative valence as well as high and low arousal values.
[63]	2019	Depression	25 (- / 25)	DSM-IV	- (3)	Bandpass Butterworth Filter	*SVM* , PNN	Alpha, Beta, Delta, Theta and full band	97.8	–	–	This study concludes that the analysis of full band is better than any other band; 10 second epochs give the best results and no significant differences between overlapping and non-overlapping.

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[112]	2011	Depression	90 (45 / 45)	DSM-IV, BDI	- (19)	Highpass filter with 0.5 Hz, lowpass filter with 70 Hz, Notch filter	KNN, LDA, *LR*	*Alpha* , Beta, Delta, Theta	90 (all nonlinear features)	_	_	LR classifier results higher performance than any other classifiers for distinguishing the control and depressed subjects.
[46]	2020	MDD	64 (30 / 34)	_	- (20)	_	Dual-CNN	_	98.81	98.36	99.31	Dual CNN model followed by three layers of fully connected layers has been designed that allows faster identification of depression presence.
[47]	2019	MDD	60 (30 / 30)	_	19 electrodes EEG Device (2)	_	CNN, *VGG16*	_	87.5	_	_	Prefrontal brain asymmetry based image with 16-layered VGG16 model showed higher accuracy with two channel EEG electrodes.
[65]	2015	Depression	25 (- / 25)	_	- (8)	Butterworth bandpass filter	ANN, *SVM*	*Alpha* , Beta, Delta, Theta	84	83.33	91.3	Linear EEG features were analyzed by ANN architecture using FFT to differentiate the control and healthy groups.
[66]	2006	Depression	30 (10 / 20)	_	16 electrodes EEG Device (16)		ANN	Alpha, Beta, Delta, Theta	60	_	_	A multi-layer feed-forward ANN approaches was used for identifying the Schizophrenia and depressed patients from the view of rhythm's power.

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[67]	2019	Depression	60 (30 / 30)	_	19 electrodes EEG Device (4)	50Hz Notch filter	CNN		99.31% (right) 96.3% (left)	_	_	5 layer of CNN approach was constructed and found the highest performance observed within right brain hemisphere although network performance significantly diminished by the number of epochs, learning rate and training data size.
[48]	2019	Clinical Depression	30 (- / 30)	_	19 electrodes EEG Device (4)	50Hz Not+H51:V51 ch Filter, total variation filtering algorithm	CNN-LSTM, *ConvLSTM*		accuracy with root mean square error of 0.000064			This study focuses on the performance comparison between two LSTM models i.e. CNN-LSTM ans ConvLSTM based on RMSE. Here ConvLSTM is the matrix multiplication of LSTM cell replaced by the convolution operation and CNN-LSTM is combination of CNN and LSTM models.
[68]	2019	Depression	55 (28 / 27)	PHQ-7, GAD-7	128-HydroCel Geodesic Sensor Net	Hamming Window based Sinc FIR Filter, TrimOutliner Plugin	*SVM* , KNN, DT, NB	full, alpha, beta, delta, theta	92.73	_	_	This study found best performance for the combinations of the linear SVM and alpha frequency band and concludes that depression affects brain activity in nearly whole cortex.

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[113]	2019	three level of depression	60 (- / 60)	DSM-IV, BDI-II	19 electrodes EEG Device (19)	Butterworth filter, notch filter, ICA, PCA	*FFNN* , SVM	_	90	_	_	From two classifier i.e. multi-class SVM and FFNN, FFNN performs better subjects' depression level identification for the three nonlinear features-- FuzzyEn, FuzzyFractal, KATZ.
[74]	2020	anxeity and depression	20 (10 / 10)	HAM-D	Brain Products (32)	Butterworth 6th order filter, notch filter	DBN, LDA, *CNN*	Alpha, Beta, Delta, Theta, Gamma	67.67	_	_	The combination of brain functional connectivity and CNN fusioned with DBN and LDA showed better discrimination of EEG-based depression between healthy and depressed group.
[75]	2020	Depression due to Epileptic seizure	246 (- / 246)	_	TUH EEG	hilbert transform	*CNN with Adam Optimizer and 10 folded cross validation (CNN1, CNN2, CNN3, CNN4)* , SVM	Delta, Theta, Alpha, Low beta, High beta, Low gamma, High gamma	83	95	65	This study classified the depression due to eight different epileptic seizures through heterogeneous EEG dataset and CNN model trained on features of synchronization and power spectrum.
[23]	2020	MDD	64 (30 / 34)	DSM-IV	19-channel EEG Device (16)	ICA	2D-CNN	*alpha* , theta, beta, delta	98.85	98.84	98.66	Deep-asymmetry method using image asymmetry matrix along with the CNN model has been developed differentiating the features by preserving the spatial characteristics of the EEG channel.

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[37]	2020	Mild Depression	51 (27 / 24)	BDI-II	128-channel HydroCel Geodesic Sensor Net (128)	high-pass filtered and low-pass filter, Net Station Waveform Tools, FastICA	24-folded cross validation CNN	*delta* , theta, alpha, beta, *gamma*	80.74	–	–	Separate CNN model applied to the two-dimensional data form of the functional connectivity matrices from five EEG bands and merged the functional connectivity matrices from the three EEG bands that performed the best into a three-channel image to classify mild depression.
[49]	2019	MDD	22 (- / 22)	HAM-D	Emotiv EPOC 14 (14)	asking participants to close their eyes and avoid movement.	PEER	alpha, theta	74	58	91	This study demonstrated PEER model with qEEG features and frequency band abnormalities of alpha and theta band showed promising combinatorial measures such as cordance and prediction of Treatment Response Index.
[69]	2020		24 (12 / 12)	_	Brain Products (6)		*HybridEEGNet* , SynEEGNet, RegEEGNet, DeepConvNet , AchCNN, EEGNet	alpha, theta	79.08	68.78	84.45	An extensive CNN model named HybridEEGNet composed of two parallel lines illustrated to learn the synchronous EEG features, and differentiate control groups from medicated and unmediated MDD patients.

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[31]	2019		39 (19 / 20)	BDI-II	HydroCel Geodesic Sensor Net (HCGSN) (!28)	Net Station Waveform Tools, FastICA for ocular artifacts	Linear SVM, RBF SVM, GBD Tree, RF, SNN, BNMLP	*Alpha* , Beta, Delta, Theta, Gamma	83.42	–	–	The outcomes of this study refers that the EEGEM synchronization acquisition network ensures the both recorded EM and EEG data streams are synchronized with millisecond precision, and fusion methods can improve mild depression recognition accuracy.
[33]	2020	MDD	55 (32 / 23)	MADRS			RF		99.72	99.37	99.91	This study showed the comparison between motor activity data from night, day & full day, carried out through a data mining process using RF classifier and best dataset and classification accuracy ensures the depression episode more condensed with night motor activity.
[76]	2020	Depression due to stress	26 (- / 26)	MIST	19-channel EEG (19)	No artifact elimination method was applied to raw EEG data	*CNN* , LR, DT, SVM	alpha, beta, gamma, theta, delta	96	95	97	A real time mental stress assessment method using sliding window based CNN model has been analyzed in terms of time utilization, quality of features, and size of sliding window.

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[70]	2020	depression	20 (10 / 10)	BDI, DASS, FFMQ	Quikcap (62)		*SNN* , MLP, MLR, SVM		73	_	_	SNN technique designed for modelling the brain data and concluded differentiating brain states based on distinct task demands and stimuli as well as changes of psychological intervention.
[114]	2018	MDD	64 (30 / 34)	_	19 channel EEG (19)		MLRW, *CNN*	_	98.87	98.4	99.7	An online EEG classification system has designed centering on a lightweight CNN, which was deployed at the Google Collaborator for offline training and on Gateways at the user end for online classification.
[71]	2018	Depression	213 (121 / 92)	_	3 channel EEG (3)	cascade of three adaptive flters based on the LMS algorithm, ICA, FIR filter,	SVM, ANN, *KNN* , CT	alpha, beta, gamma, theta, delta	76.98	_	_	Both linear and non-linear EEG features collected from three Pervasive electrodes located at prefrontal cortex fed on four different classifier and of them, KNN model performed with higher accuracy and found that absolute theta power might identifies the depression.

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[20]	2020	MDD	92 (46 / 46)	ICD-10, DSM-IV, HAM-D	NeuroScan/ Scan LT (19)	3 Hz, 35 Hz, and 50 Hz band-stop filter, FastICA, 12th Order Butterworth filter, Parks-McClellan optimal FIR	CNN (ResNet-50, Inception-V3, *MobileNet*), FFT-Cordance	*delta* , theta, alpha, beta	92.66 (right) 89.33 (left)	–	–	The study designed with deep learning model and revealed that the higher average delta amplitude found in MDD compared to the healthy control subjects which is one of the translational biomarker for depression presence.
[51]	2015	MDD	10 (- / 10)	DSM-IV	19-channel Neuroscan Synamps II (2)	Low pass filter (0.5-70) Hz, Notch filter	SVM	alpha, beta, gamma, theta, delta	90.2	92.6	92.1	OCD based depressed patients are characterized by lower functional abnormalities and EEG complexity at both pre-frontal regions and right fronto-temporal locations.
[52]	2019	MDD	35 (12 / 23)	DSM-IV, HAM-D17	32 surface electrode (2)	Z-score normalizatio n, DWT, db5 wavelet base	KNN, *LDA* , RF, CART	alpha, beta, gamma, theta, delta	88	91	86	Non-linear features extracted from less number of channel from the frontal region can possibly demonstrate the results of multi-channel EGG analysis
[53]	2014	Clinical Depression	30 (- / 30)	_	19 electrodes EEG Device (4)	50Hz Not+H51:V51 ch Filter, total variation filtering algorithm	GMM, DT, KNN, NB, *PNN* , FSC, SVM	_	99.5	99.2	99.7	Right-side hemisphere showed the accuracy about 1% higher from the left-side hemisphere for discriminating the healthy control and depressed group

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[80]	2021	Depression	44(22/22)	_	Bipolar EEG Channel (2)	low-pass Butterworth filter with a cutoff frequency of 80 Hz	SVM, KNN	_	97.74 (left) 99.30 (right)	97.81 (left) 99.30 (right)	97.67 (left) 99.30 (right)	The communication between synapses in the depressed brain decreases compared to the normal brain. This is the reason for the less complexity of RPS shape in the depressed group compared to the normal group.
[65]	2021	Clinical Depression	30 (14/16)	HAMD, SAS, SDS	QuickCap™, Brain Products Inc., Gilching, Bavaria, Germany (59)	ocular correction algorithm (BrainVision), 0.05 and 100 Hz bandpass filter	SVM, KNN, LR	alpha, beta, gamma, theta, delta, full band	85.7% (negative stimuli)			gamma oscillation presented regular network characteristics during emotional processing;
[81]	2021	depression	33 (18/15)	PHQ-9	19-channel with mean ear electrodes (19)		AchLSTM, AchCNN, T-LSTM, H-KNN, H-KNN2, S-EMD, S-SVM, H-DBN, DeprNet		99.37			Topology heat map results suggest that depression affects the activities of different hemispheres of the brain differently. On the other hand, batch normalization has been adopted one layer after each convolutional layer to stabilize the network by normalization of previous layer and they found better convergence rate.