

## APPENDIX B

# EXPERIMENTAL RESULTS BY CRITERION 2

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This appendix contains the results obtained of the classification three classes of EEG signals, Ictal, Interictal and Healthy using several strategies and classifiers. The results reported here were obtained using the feature extraction calculated by the criterion 2, different combinations of filters and wavelet transforms. Two approaches for filtering were tested, FIR and IIR filters. The filtering of the EEG signals was performed in order to remove noise added during recording of the EEG signals. The decomposition of EEG signals into delta ( $\delta$ ) and alpha ( $\alpha$ ) sub-bands and feature extraction were carried out using the DWT and MODWT by the criterion 2 for the suitable wavelet choice. The criterion 2 uses the wavelet that provides the highest times number with the best correlation coefficient obtained for each class of the EEG signals, therefore the feature extraction was done with Coiflet 3 (Coif3), Symlet 8 (Sym 8) and Daubechies 6 (Db6) for Ictal, Interictal and Healthy EEG signals, respectively. Then, each EEG signal was represented by a feature vector of six components, built using the mean, absolute median and variance of  $\delta$  and  $\alpha$  sub-bands. Therefore, the feature vectors obtained are considered as inputs for the classifiers described in this work. The EEG signals used in the experiments reported in this research come from a free-available EEG database, provided by the University

of Bonn [BON16].

## B.1 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON FF-ANN AND ELMAN CLASSIFIERS WITH WAVELET DECOMPOSITION BY CRITERION 2.

Tables B.1 and B.2 present the results of the classification of three classes of EEG signals based on FFANN and Elman, respectively. These classifiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 2. In order to find the best number of hidden nodes for the FF-ANN and Elman networks, tests were done using 6, 9, 12, 15, 16, 18, 21 and 24 nodes in the hidden layer of each network. Levenberg-Marquardt algorithm was the training method used for the FF-ANN, whereas gradient descent was the training method used for the Elman network. The experimental results reported here were obtained with a learning rate of 0.05 , a  $MSE_{max}$ ) of 0.01, whereas the maximum number of training epochs was fixed at 1000. The experiments based on FFANN and Elman network were executed using two activation functions, Sigmoid and Hyperbolic tangent. The best results in each case are bolded and them are summarized in Table 5.4 of this thesis.

**Table B.1:** Results of the classification of three classes of EEG signals based on FF-ANN using Sigmoid and Hyperbolic tangent as activation functions with wavelet decomposition by criterion 2.

Activation function	Extraction feature	Hidden nodes	Accuracy (%)	
Sigmoid	Chebyshev II - DWT	6	90.66	
	Chebyshev II - MODWT	12	90.00	
	Elliptic - DWT	21	90.33	
	Elliptic - MODWT	9	92.66	
	<b>Equiripple - DWT</b>	<b>24</b>	<b>93.00</b>	
	Equiripple - MODWT	9	89.00	
	Least Squares - DWT	24	89.66	
	Least Squares - MODWT	9	90.33	
	Hyperbolic tangent	Chebyshev II - DWT	6	92.33
		Chebyshev II - MODWT	15	90.33
Elliptic - DWT		18	92.33	
Elliptic - MODWT		24	91.33	
<b>Equiripple - DWT</b>		<b>21</b>	<b>94.33</b>	
Equiripple - MODWT		9	88.33	
Least Squares - DWT		9	92.33	
Least Squares - MODWT		9	91.33	

**Table B.2:** Results of the classification of three classes of EEG signals based on Elman using Sigmoid and Hyperbolic tangent as activation functions with wavelet decomposition by criterion 2.

Activation function	Extraction feature	Hidden nodes	Accuracy (%)	
<b>Sigmoid</b>	Chebyshev II - DWT	18	58.33	
	Chebyshev II - MODWT	18	60.00	
	Elliptic - DWT	12	63.00	
	Elliptic - MODWT	24	82.66	
	Equiripple - DWT	18	60.66	
	Equiripple - MODWT	24	65.00	
	Least Squares - DWT	24	78.33	
	<b>Least Squares - MODWT</b>	<b>24</b>	<b>87.66</b>	
	<b>Hyperbolic tangent</b>	Chebyshev II - DWT	24	79.00
		<b>Chebyshev II - MODWT</b>	<b>15</b>	<b>82.33</b>
Elliptic - DWT		24	64.00	
Elliptic - MODWT		21	76.66	
Equiripple - DWT		24	73.33	
Equiripple - MODWT		21	78.66	
Least Squares - DWT		18	73.00	
Least Squares - MODWT		24	77.00	

## B.2 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON WNN CLASSIFIERS USING A BINARY-TREE STRATEGY WITH WAVELET DECOMPOSITION BY CRITERION 2.

Tables B.3 - B.8 present the results of the classification of three classes of EEG signals based on WNN (FFWNN, MRW-FFWNN, SRWNN and MR-SRWNN) with different structures using a binary-tree strategy. These classifiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 2. These experiments were executed using 60 neurons in the layer 2, a learning rate of 0.001, a  $MSE_{max}$  de 0.1, a  $N_{Epochs}$  of 100 and Mexican hat as activation function in each classifier. The best results in each case are bolded and them are summarized in Table 5.6 of this thesis.

## B.3 RESULTS OF THE CLASSIFICATION OF THREE CLASSES OF EEG SIGNALS BASED ON WNN CLASSIFIERS USING VOTE AND WV IN A OVO SCHEME WITH WAVELET DECOMPOSITION BY CRITERION 2.

Tables B.9 and B.10 present the results of the classification of three classes of EEG signals based on WNN (FFWNN, MRW-FFWNN, SRWNN and MR-SRWNN) by the VOTE and WV strategies using OVO decomposition scheme. These classi-

**Table B.3:** Classification of EEGs based on WNN using binary-tree structure: Ictal-Interictal-Healthy (Ic-In-H) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Ictal	Interictal	Healthy	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	70.65	70.15	55.53	10.00	65.83
	(4) MRW-FFWNN	92.87	80.52	55.56	1.67	79.50
	(5) SRWNN	72.32	67.33	43.08	10.83	63.67
	(6) MRW-SRWNN	72.75	71.59	31.46	11.50	61.50
Chebyshev II - MODWT	(3) FFWNN	73.14	60.23	57.01	12.00	65.00
	(4) MRW-FFWNN	100.00	89.75	89.00	0.83	94.50
	(5) SRWNN	81.20	62.97	53.67	10.33	68.33
	(6) MRW-SRWNN	82.74	69.31	51.10	7.00	70.67
Elliptic - DWT	(3) FFWNN	73.83	63.16	51.66	9.50	65.33
	(4) MRW-FFWNN	95.09	78.53	49.07	1.33	79.17
	(5) SRWNN	74.17	64.32	41.28	9.83	63.33
	(6) MRW-SRWNN	78.21	61.62	33.15	10.67	62.83
Elliptic - MODWT	(3) FFWNN	71.63	55.71	57.34	12.67	64.00
	(4) MRW-FFWNN	100.00	86.96	90.22	0.33	94.33
	(5) SRWNN	72.69	54.38	56.49	13.17	63.83
	(6) MRW-SRWNN	76.62	74.06	39.40	8.50	67.17
Equiripple - DWT	(3) FFWNN	65.63	54.46	51.69	11.33	59.00
	(4) MRW-FFWNN	92.75	79.17	56.04	2.17	79.83
	(5) SRWNN	67.82	59.40	43.07	15.67	59.00
	(6) MRW-SRWNN	71.80	71.58	27.39	11.33	60.00
Equiripple - MODWT	(3) FFWNN	69.61	54.07	59.67	14.52	62.86
	(4) MRW-FFWNN	100.00	91.43	91.02	0.48	95.48
	(5) SRWNN	73.82	54.07	62.60	11.90	65.71
	(6) MRW-SRWNN	82.28	67.68	41.55	7.38	69.29
Least squares - DWT	(3) FFWNN	64.25	63.68	42.57	10.28	58.06
	(4) MRW-FFWNN	92.65	81.55	59.52	2.50	81.11
	(5) SRWNN	69.87	60.45	41.57	13.33	59.72
	(6) MRW-SRWNN	68.24	69.96	32.03	10.56	59.72
Least squares - MODWT	(3) FFWNN	72.83	59.47	51.68	13.10	63.81
	(4) MRW-FFWNN	<b>100.00</b>	<b>89.81</b>	<b>92.81</b>	<b>0.00</b>	<b>95.71</b>
	(5) SRWNN	77.20	56.67	52.49	13.10	65.24
	(6) MRW-SRWNN	79.56	75.28	39.01	7.38	68.10

**Table B.4:** Classification of EEGs based on WNN using binary-tree structure: Ictal-Healthy-Interictal (Ic-H-In) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Ictal	Healthy	Interictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	70.94	77.16	24.92	11.43	61.90
	(4) MRW-FFWNN	93.57	94.04	40.67	1.90	80.95
	(5) SRWNN	70.75	64.75	17.09	14.76	56.43
	(6) MRW-SRWNN	70.86	64.63	19.76	14.29	57.62
Chebyshev II - MODWT	(3) FFWNN	66.50	81.96	16.04	20.71	58.33
	(4) MRW-FFWNN	91.02	100.00	74.41	2.86	89.05
	(5) SRWNN	61.31	67.24	22.64	27.14	53.81
	(6) MRW-SRWNN	70.31	83.99	27.25	14.52	62.86
Elliptic - DWT	(3) FFWNN	62.51	66.51	13.74	20.00	52.38
	(4) MRW-FFWNN	84.78	94.52	54.09	4.29	80.00
	(5) SRWNN	63.09	72.52	18.78	14.52	55.48
	(6) MRW-SRWNN	71.94	81.07	19.76	11.19	62.62
Elliptic - MODWT	(3) FFWNN	68.06	63.71	25.23	23.81	55.48
	(4) MRW-FFWNN	96.65	100.00	80.22	0.24	93.10
	(5) SRWNN	68.06	58.10	30.74	21.43	55.95
	(6) MRW-SRWNN	76.02	87.50	27.02	7.86	66.19
Equiripple - DWT	(3) FFWNN	58.45	62.00	23.99	18.10	51.19
	(4) MRW-FFWNN	90.97	93.52	49.65	2.62	81.19
	(5) SRWNN	61.15	63.02	17.41	19.29	51.43
	(6) MRW-SRWNN	76.53	70.94	19.46	10.95	60.00
Equiripple - MODWT	(3) FFWNN	64.87	70.77	32.27	20.95	56.90
	(4) MRW-FFWNN	96.78	100.00	83.94	1.19	93.81
	(5) SRWNN	67.97	70.09	29.58	22.86	57.38
	(6) MRW-SRWNN	75.52	80.61	25.62	11.43	62.86
Least squares - DWT	(3) FFWNN	58.55	64.26	15.80	15.48	50.71
	(4) MRW-FFWNN	87.59	91.85	46.07	3.57	79.52
	(5) SRWNN	62.29	74.52	14.73	15.71	55.24
	(6) MRW-SRWNN	73.25	80.32	22.18	12.14	63.81
Least squares - MODWT	(3) FFWNN	68.02	66.45	27.64	22.62	58.33
	(4) MRW-FFWNN	<b>99.10</b>	<b>100.00</b>	<b>85.90</b>	<b>0.95</b>	<b>96.43</b>
	(5) SRWNN	72.89	64.00	26.59	21.90	60.48
	(6) MRW-SRWNN	74.45	75.79	22.46	12.62	63.33

**Table B.5:** Classification of EEGs based on WNN using binary-tree structure: Interictal-Ictal-Healthy (In-Ic-H) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Interictal	Ictal	Healthy	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	70.81	64.36	47.60	7.14	62.86
	(4) MRW-FFWNN	84.44	80.41	60.62	3.57	77.14
	(5) SRWNN	75.06	62.72	39.74	8.33	62.86
	(6) MRW-SRWNN	77.08	68.43	25.35	8.33	60.95
Chebyshev II - MODWT	(3) FFWNN	63.60	63.94	48.08	15.67	59.67
	(4) MRW-FFWNN	94.83	92.38	89.61	0.67	92.67
	(5) SRWNN	65.09	61.70	52.85	11.67	61.00
	(6) MRW-SRWNN	73.57	81.58	47.49	4.33	69.00
Elliptic - DWT	(3) FFWNN	74.13	65.63	50.73	3.67	64.33
	(4) MRW-FFWNN	85.36	84.74	57.29	3.00	76.33
	(5) SRWNN	75.56	66.90	44.54	8.00	63.33
	(6) MRW-SRWNN	77.71	82.14	42.00	7.67	68.00
Elliptic - MODWT	(3) FFWNN	61.60	64.44	66.80	13.67	64.00
	(4) <b>MRW-FFWNN</b>	<b>96.86</b>	<b>94.58</b>	<b>87.80</b>	<b>0.00</b>	<b>94.00</b>
	(5) SRWNN	61.48	70.76	64.15	9.67	65.00
	(6) MRW-SRWNN	79.28	78.36	33.35	8.00	68.33
Equiripple - DWT	(3) FFWNN	62.44	59.22	56.05	14.00	58.67
	(4) MRW-FFWNN	92.07	81.24	63.59	1.33	83.00
	(5) SRWNN	73.28	57.17	66.30	8.67	66.67
	(6) MRW-SRWNN	74.99	66.84	42.75	8.67	64.67
Equiripple - MODWT	(3) FFWNN	60.38	59.61	59.38	10.33	60.33
	(4) <b>MRW-FFWNN</b>	<b>94.67</b>	<b>90.37</b>	<b>96.16</b>	<b>0.33</b>	<b>94.00</b>
	(5) SRWNN	59.18	56.20	56.53	12.00	57.67
	(6) MRW-SRWNN	74.16	65.22	50.34	8.67	66.00
Least squares - DWT	(3) FFWNN	68.73	56.85	48.75	8.67	60.67
	(4) MRW-FFWNN	85.94	87.81	59.00	2.33	79.67
	(5) SRWNN	73.94	66.16	39.32	10.33	63.33
	(6) MRW-SRWNN	85.08	71.30	23.14	6.00	65.33
Least squares - MODWT	(3) FFWNN	53.73	56.83	61.51	14.67	57.00
	(4) MRW-FFWNN	81.59	95.53	100.00	2.00	90.00
	(5) SRWNN	51.65	65.13	65.32	12.00	58.67
	(6) MRW-SRWNN	76.12	70.82	48.71	6.00	67.67



**Table B.6:** Classification of EEGs based on WNN using binary-tree structure: Interictal-Healthy-Ictal (In-H-Ic) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Interictal	Healthy	Ictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	67.38	47.38	53.99	10.17	58.67
	(4) MRW-FFWNN	86.07	49.60	78.24	2.67	74.50
	(5) SRWNN	66.87	45.71	50.84	11.17	57.50
	(6) MRW-SRWNN	80.78	25.01	62.71	10.50	61.17
Chebyshev II - MODWT	(3) FFWNN	55.42	59.47	63.43	14.67	57.83
	<b>(4) MRW-FFWNN</b>	<b>94.91</b>	<b>85.65</b>	<b>89.26</b>	<b>0.67</b>	<b>91.33</b>
	(5) SRWNN	54.42	63.20	61.78	14.17	57.83
	(6) MRW-SRWNN	74.15	43.81	71.18	6.50	65.33
Elliptic - DWT	(3) FFWNN	70.05	50.48	58.56	8.17	62.17
	(4) MRW-FFWNN	88.88	54.87	80.24	2.00	78.50
	(5) SRWNN	75.66	41.81	61.80	7.33	63.33
	(6) MRW-SRWNN	73.56	34.50	62.05	8.33	60.83
Elliptic - MODWT	(3) FFWNN	54.11	65.22	56.84	17.33	57.50
	(4) MRW-FFWNN	86.63	86.18	91.52	2.83	87.17
	(5) SRWNN	54.75	63.31	60.18	16.17	58.17
	(6) MRW-SRWNN	74.67	40.71	67.11	5.83	63.83
Equiripple - DWT	(3) FFWNN	69.50	42.96	55.78	7.17	59.33
	(4) MRW-FFWNN	87.48	50.37	82.12	1.00	76.33
	(5) SRWNN	74.33	45.11	52.21	7.17	61.33
	(6) MRW-SRWNN	76.81	28.34	64.30	8.33	61.83
Equiripple - MODWT	(3) FFWNN	56.58	54.77	62.72	10.67	57.67
	(4) MRW-FFWNN	81.76	94.64	92.48	2.83	87.83
	(5) SRWNN	57.76	52.35	66.06	12.00	58.67
	(6) MRW-SRWNN	68.43	50.47	72.67	6.17	65.33
Least squares - DWT	(3) FFWNN	70.43	39.51	57.71	11.17	59.67
	(4) MRW-FFWNN	82.27	54.39	74.39	3.67	73.50
	(5) SRWNN	69.42	46.72	61.09	9.00	61.83
	(6) MRW-SRWNN	76.59	25.63	68.37	7.17	62.00
Least squares - MODWT	(3) FFWNN	56.36	53.63	65.77	12.33	57.33
	(4) MRW-FFWNN	87.97	91.68	95.13	2.83	90.17
	(5) SRWNN	58.76	54.81	60.18	10.00	57.67
	(6) MRW-SRWNN	75.43	44.43	72.77	6.17	66.33

**Table B.7:** Classification of EEGs based on WNN using binary-tree structure: Healthy-Ictal-Interictal (H-Ic-In) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Healthy	Ictal	Interictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	90.19	63.52	20.01	5.00	65.33
	(4) MRW-FFWNN	95.17	92.35	46.90	1.33	82.33
	(5) SRWNN	74.28	65.52	25.12	9.00	59.00
	(6) MRW-SRWNN	87.22	69.75	16.38	10.67	64.67
Chebyshev II - MODWT	(3) FFWNN	81.72	74.93	28.14	7.67	64.00
	(4) MRW-FFWNN	100.00	100.00	84.71	0.67	95.67
	(5) SRWNN	80.89	77.90	23.28	8.67	63.00
	(6) MRW-SRWNN	98.70	72.07	31.92	3.33	73.00
Elliptic - DWT	(3) FFWNN	83.14	62.07	23.44	9.00	64.00
	(4) MRW-FFWNN	94.54	83.63	42.18	0.67	79.33
	(5) SRWNN	80.67	71.43	30.99	8.67	67.00
	(6) MRW-SRWNN	78.67	74.52	31.18	10.33	66.67
Elliptic - MODWT	(3) FFWNN	78.80	75.44	26.41	7.67	63.67
	(4) MRW-FFWNN	100.00	100.00	78.19	0.33	94.00
	(5) SRWNN	81.46	66.08	29.94	7.00	62.67
	(6) MRW-SRWNN	90.02	71.99	24.64	5.33	67.00
Equiripple - DWT	(3) FFWNN	85.54	72.31	23.81	5.67	68.33
	(4) MRW-FFWNN	98.16	95.13	36.24	1.67	84.00
	(5) SRWNN	83.13	67.23	24.86	7.33	66.33
	(6) MRW-SRWNN	79.60	68.55	28.71	10.33	65.67
Equiripple - MODWT	(3) FFWNN	88.87	68.76	20.54	9.67	65.00
	(4) MRW-FFWNN	100.00	100.00	78.17	0.67	94.00
	(5) SRWNN	84.97	67.98	25.06	8.33	64.00
	(6) MRW-SRWNN	94.55	76.69	31.92	6.00	72.67
Least squares - DWT	(3) FFWNN	78.98	64.32	31.31	6.33	63.00
	(4) MRW-FFWNN	92.17	87.31	39.23	0.33	77.00
	(5) SRWNN	76.87	65.45	21.12	10.00	59.67
	(6) MRW-SRWNN	88.12	63.26	20.29	7.33	64.33
Least squares - MODWT	(3) FFWNN	84.16	72.00	32.48	9.67	67.33
	(4) MRW-FFWNN	<b>100.00</b>	<b>100.00</b>	<b>83.68</b>	<b>0.33</b>	<b>96.00</b>
	(5) SRWNN	84.48	72.52	29.73	10.67	67.33
	(6) MRW-SRWNN	88.15	71.90	41.49	8.00	72.00

**Table B.8:** Classification of EEGs based on WNN using binary-tree structure: Healthy-Interictal-Ictal (H-In-Ic) with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)				
		Healthy	Interictal	Ictal	Indeter	Total
Chebyshev II - DWT	(3) FFWNN	81.92	24.89	53.86	9.00	59.33
	(4) MRW-FFWNN	97.17	42.55	72.36	2.33	76.00
	(5) SRWNN	81.56	29.49	57.33	8.33	60.67
	(6) MRW-SRWNN	81.00	14.95	58.42	6.67	57.33
Chebyshev II - MODWT	(3) FFWNN	73.44	29.49	60.03	11.00	58.33
	(4) MRW-FFWNN	100.00	79.66	93.52	0.67	93.00
	(5) SRWNN	73.92	42.80	62.02	7.67	63.00
	(6) MRW-SRWNN	97.95	37.94	72.33	5.00	75.00
Elliptic - DWT	(3) FFWNN	83.50	33.03	43.30	6.67	62.67
	(4) MRW-FFWNN	93.94	49.32	80.24	0.67	80.33
	(5) SRWNN	74.42	39.89	52.33	7.33	61.33
	(6) MRW-SRWNN	81.07	28.95	61.74	5.33	64.33
Elliptic - MODWT	(3) FFWNN	90.29	19.81	49.18	11.00	61.00
	(4) MRW-FFWNN	100.00	76.71	93.85	0.67	92.33
	(5) SRWNN	87.90	14.90	58.27	9.67	60.00
	(6) MRW-SRWNN	97.11	42.19	70.76	4.33	74.67
Equiripple - DWT	(3) FFWNN	83.83	33.17	56.22	6.33	64.33
	(4) MRW-FFWNN	90.95	52.56	83.82	1.33	79.33
	(5) SRWNN	72.97	42.13	64.03	11.00	62.67
	(6) MRW-SRWNN	77.78	25.63	72.65	7.00	63.00
<b>Equiripple - MODWT</b>	(3) FFWNN	81.79	32.53	58.44	5.67	64.67
	<b>(4) MRW-FFWNN</b>	<b>100.00</b>	<b>85.79</b>	<b>99.00</b>	<b>0.00</b>	<b>96.67</b>
	(5) SRWNN	86.74	23.42	63.99	9.00	66.33
	(6) MRW-SRWNN	95.38	32.93	68.73	3.33	74.33
Least squares - DWT	(3) FFWNN	86.92	30.09	63.75	7.00	67.33
	(4) MRW-FFWNN	87.09	44.83	85.90	2.00	76.33
	(5) SRWNN	72.77	38.59	59.50	9.33	61.00
	(6) MRW-SRWNN	76.40	27.56	77.46	8.33	64.67
Least squares - MODWT	(3) FFWNN	84.51	35.65	62.57	8.33	67.67
	(4) MRW-FFWNN	100.00	79.79	94.17	0.33	93.67
	(5) SRWNN	86.26	32.99	61.74	6.33	67.67
	(6) MRW-SRWNN	94.99	40.62	72.41	3.67	76.33

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fiers used features obtained of all the combinations of filters (Chebyshev, Elliptic, Equiripple and Least squares) and wavelets transforms (DWT and MODWT) by the criterion 2. These experiments were executed using 60 neurons in the layer 2, a learning rate of 0.001, a  $MSE_{max}$  de 0.1, a  $N_{Epochs}$  of 100 and Mexican hat as activation function in each classifier. The best results in each case are bolded and them are summarized in Table 5.8 of this thesis.

**Table B.9:** Classification of EEGs based on WNN using Vote strategy (VOTE) in a OVO decomposition scheme with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)			
		Ictal	Interictal	Healthy	Total
Chebyshev II - DWT	(3) FFWNN	86.00	44.77	88.96	75.00
	(4) MRW-FFWNN	95.00	95.24	0.00	65.00
	(5) SRWNN	74.69	52.58	74.44	68.67
	(6) MRW-SRWNN	87.16	99.05	0.95	61.33
Chebyshev II - MODWT	(3) FFWNN	88.41	31.57	96.33	70.33
	(4) MRW-FFWNN	100.00	100.00	11.18	71.67
	(5) SRWNN	81.56	32.94	95.16	68.00
	(6) MRW-SRWNN	89.61	98.89	2.13	63.67
Elliptic - DWT	(3) FFWNN	85.96	14.39	100.00	65.67
	(4) MRW-FFWNN	95.65	95.00	5.88	70.00
	(5) SRWNN	80.59	21.23	100.00	66.00
	(6) MRW-SRWNN	93.83	93.81	2.33	64.00
Elliptic - MODWT	(3) FFWNN	92.44	7.85	100.00	69.67
	(4) MRW-FFWNN	95.00	100.00	2.67	63.33
	(5) SRWNN	78.34	18.72	100.00	68.33
	(6) MRW-SRWNN	94.85	97.89	1.18	59.00
Equiripple - DWT	(3) FFWNN	91.57	24.26	94.80	69.00
	(4) MRW-FFWNN	83.33	78.26	84.21	81.67
	(5) SRWNN	85.53	31.43	93.37	69.67
	(6) MRW-SRWNN	84.71	97.39	2.11	60.67
<b>Equiripple - MODWT</b>	(3) FFWNN	97.24	49.05	100.00	81.67
	<b>(4) MRW-FFWNN</b>	<b>100.00</b>	<b>100.00</b>	<b>66.67</b>	<b>88.33</b>
	(5) SRWNN	94.59	47.00	100.00	79.67
	(6) MRW-SRWNN	95.82	100.00	4.71	68.00
Least squares - DWT	(3) FFWNN	91.09	19.37	100.00	72.33
	(4) MRW-FFWNN	94.74	100.00	2.33	63.33
	(5) SRWNN	81.97	28.16	98.10	71.33
	(6) MRW-SRWNN	86.98	90.79	1.18	56.67
Least squares - MODWT	(3) FFWNN	100.00	38.47	96.34	80.33
	(4) MRW-FFWNN	99.05	100.00	4.71	71.67
	(5) SRWNN	96.89	48.03	100.00	81.67
	(6) MRW-SRWNN	95.24	98.08	2.11	62.67

**Table B.10:** Classification of EEGs based on WNN using Weighted voting strategy (WV) in a OVO decomposition scheme with wavelet decomposition by criterion 2.

Feature extraction	Classifier	Accuracy (%)			
		Ictal	Interictal	Healthy	Total
Chebyshev II - DWT	(3) FFWNN	71.21	51.43	84.74	70.00
	(4) MRW-FFWNN	72.22	95.24	23.81	63.33
	(5) SRWNN	66.97	53.71	63.44	61.67
	(6) MRW-SRWNN	77.01	93.54	9.52	57.33
Chebyshev II - MODWT	(3) FFWNN	67.12	39.17	98.89	65.33
	(4) MRW-FFWNN	82.35	100.00	23.53	73.33
	(5) SRWNN	60.44	31.58	97.94	60.00
	(6) MRW-SRWNN	80.93	97.80	0.95	63.33
Elliptic - DWT	(3) FFWNN	72.35	72.08	68.89	70.67
	(4) MRW-FFWNN	88.24	100.0	1.33	65.00
	(5) SRWNN	64.29	76.11	45.82	61.33
	(6) MRW-SRWNN	75.10	96.89	1.82	56.00
Elliptic - MODWT	(3) FFWNN	82.30	30.84	100.00	70.00
	(4) MRW-FFWNN	95.00	100.00	29.41	78.33
	(5) SRWNN	69.21	17.19	97.99	60.00
	(6) MRW-SRWNN	86.46	100.00	2.52	64.67
Equiripple - DWT	(3) FFWNN	75.05	32.93	93.29	65.00
	(4) MRW-FFWNN	88.24	84.62	23.53	68.33
	(5) SRWNN	64.46	58.71	76.30	65.00
	(6) MRW-SRWNN	79.96	96.58	8.80	63.00
Equiripple - MODWT	(3) FFWNN	89.24	53.19	100.00	<b>80.67</b>
	(4) MRW-FFWNN	93.75	100.00	15.79	71.67
	(5) SRWNN	74.82	24.54	98.95	65.00
	(6) MRW-SRWNN	88.44	100.00	3.29	64.00
Least squares - DWT	(3) FFWNN	83.15	30.44	98.15	71.00
	(4) MRW-FFWNN	87.50	100.00	36.84	75.00
	(5) SRWNN	68.13	34.66	95.98	66.33
	(6) MRW-SRWNN	78.57	96.75	8.29	61.33
Least squares - MODWT	(3) FFWNN	91.94	50.70	100.00	80.33
	(4) MRW-FFWNN	<b>96.15</b>	<b>100.00</b>	<b>16.29</b>	<b>78.67</b>
	(5) SRWNN	69.18	9.79	96.67	57.00
	(6) MRW-SRWNN	86.42	99.00	4.29	66.33