QEEG-based TabNet classifier for dementia pathologies: Alzheimer's disease and Lewy body disease

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TabNet classifier of Alzheimer's Disease and Lewy Body Disease using QEEG

INTRODUCTION

- We used a QEEG-based algorithm to differentiate Alzheimer's disease(AD) and Lewybody dementia(LBD).
- Despite current diagnostic measures, a significant number of LBD cases are undetected or misdiagnosed as AD [2].
- [1] attempted a study on the classification of AD and LBD using RandomForest. Further, the objective of [3] was to contrast the EEG characteristics among LBD/AD+, 'pure'LBD(LBD/AD-) and AD.
- We aimed to address the diagnostic bias in which approximately 70% of dementia diagnoses are attributed to AD, potentially overlooking the presence of LBD.
- The model's efficacy is further evaluated on mixed dementia cases presenting both Alzheimer's and Lewy body symptoms.

METHODS

- 19 channel EEG data, recorded according to the 10-20 system in a resting state, were processed through iSyncBrain®, and automated QEEG platform, to extract sensor-level features for TabNet structure training.
- To address data imbalance, time window-based augmentation applied to EEG sensor level features, creating a final dataset of 7292 samples (AD = 3376, LBD = 3916).
- The dataset was the divided in an 8:2 ratio for model training and testing,
- Mixed type dementia cases were also used to further validate the model's performance.

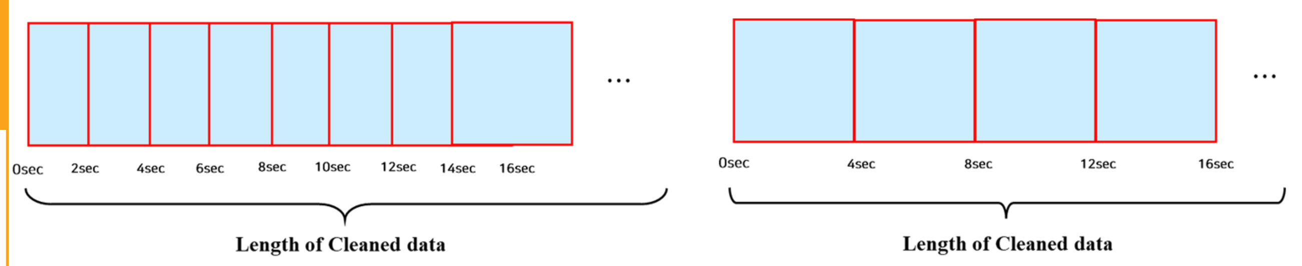
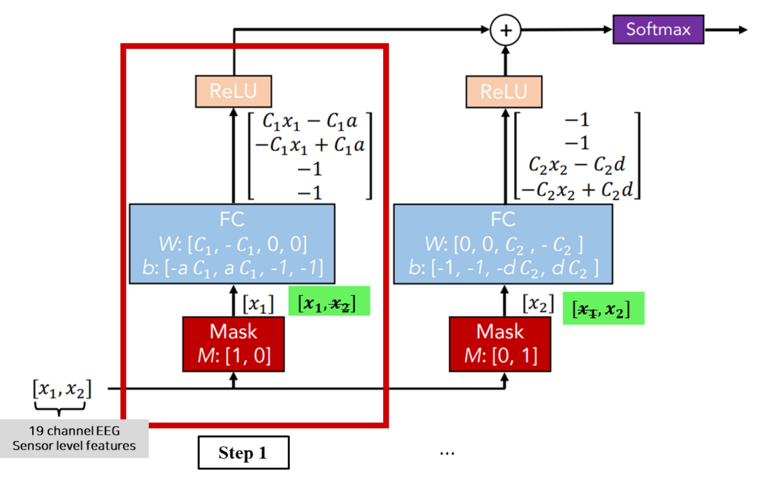


Fig 1. Data augmentation on overlapping pureAD and pureLBD

	Train	Valid	Test
Original	96	24	30
Augmentation	5755	1387	-
Total	5851	1411	30

Train		Valid		Test	
pureAD	pureLBD	pureAD	pureLBD	pureAD	pureLBD
2710	3141	656	755	10	20

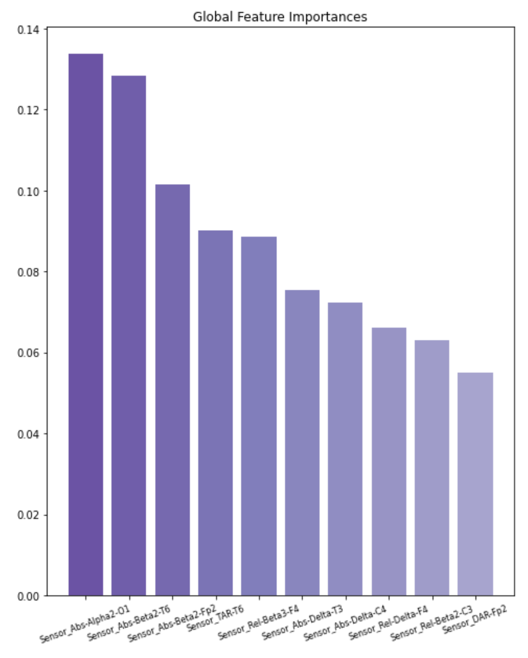
Table 1. Table of augmented dataset number of Train, Valid and test ; pureAD and pureLBD



N_d : 8
N_a : 8
N_steps : 10
γ : 1.3
Mask_type : sparsemax

Input_dim : 342
↓
Output_dim : 2

Fig 2. The process feature selection is performed at each step using DNN and the optimal hyperparameters



	Global Feature Importance Rank
Sensor_Abs-Alpha2-O1	1
Sensor_Abs-Beta2-T6	2
Sensor_Abs-Beta2-Fp2	3
Sensor_TAR-T6	4
Sensor_Abs-Delta-C4	7
Sensor_Rel-Beta2-C3	9

Fig 3. Top10 Global feature importance barplot

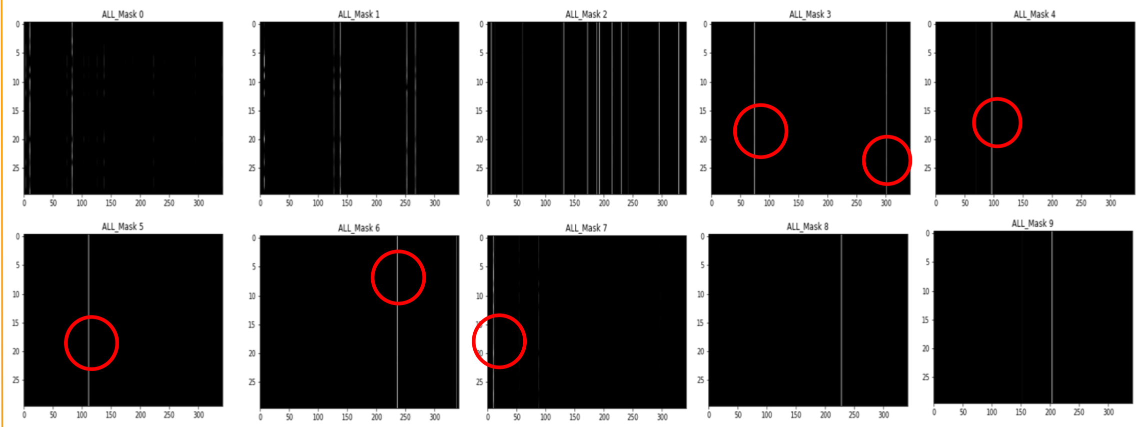


Fig 4. Masked Feature subset ; red circle represents the features in fig 3.

RESULTS

- This classifier yielded test accuracy of 80% with pure AD sensitivity at 80% and pure LBD sensitivity 80%.

	Pred pureAD	Pred pureLBD
True pureAD	8	2
True pureLBD	4	16

Table 2. Confusion matrix for the testset of the QEEG TabNet classifier

CONCLUSIONS

- Moreover, the predicted probability for mixed dementia data were prominently concentrated around 0.5.
- This model successfully identifies distinctive markers and differentiates between AD and LBD.

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