Novel quantitative electroencephalogram feature image adapted for deep learning: Verification through classification of Alzheimer's disease dementia

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Purpose

- QEEG(Quantitative Electroencephalography), the topography of spectral power showing brain activity, has been used to diagnose several neurological disorders.
- Although spectral topography is useful for visualizing brain activity, topography in certain frequency bands is difficult to interpret brain-wide functions because of the use of topography in various frequency ranges.
- Topography's data is difficult to use in deep learning models.
- Therefore, QEEG feature images is developed using various frequency ranges of Topography to interpret brain-wide function.
- The developed QEEG feature image that uses a deep learning algorithm is utilized to select Alzheimer's disease dementia (ADD).

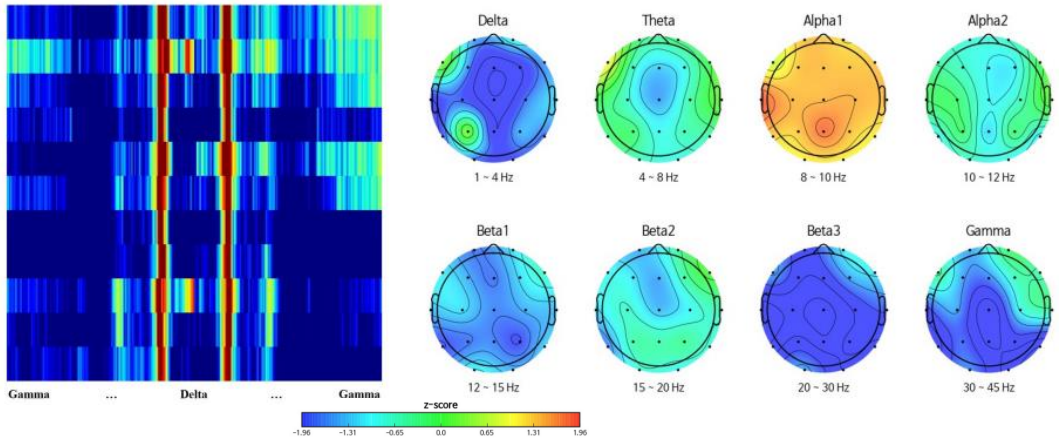
Subjects / Methods

- Main: EEG data from iMedisync's Normative DataBase which is 1,289 healthy people aged 4.5 to 81(Male = 553 people, Female = 736 people)
- Using a Z-score of 1.96, a range of colors and a matrix is created and visualized by topography.
- Using different interpolation methods (Nearest, Bicubic, Weight map, Rescaled) to create four datasets of rectangular images measured 152 x 152 pixels
- Data from ADD : 137 people and Non-ADD : 628 people(Normal = 224 people, Subjective Cognitive Impairment = 262 people, Mild Cognitive Impairment = 142 people) is used on building the algorithm.
- Final model, a model that performs the best, out of 3 models is chose to sort out ADD.

Results

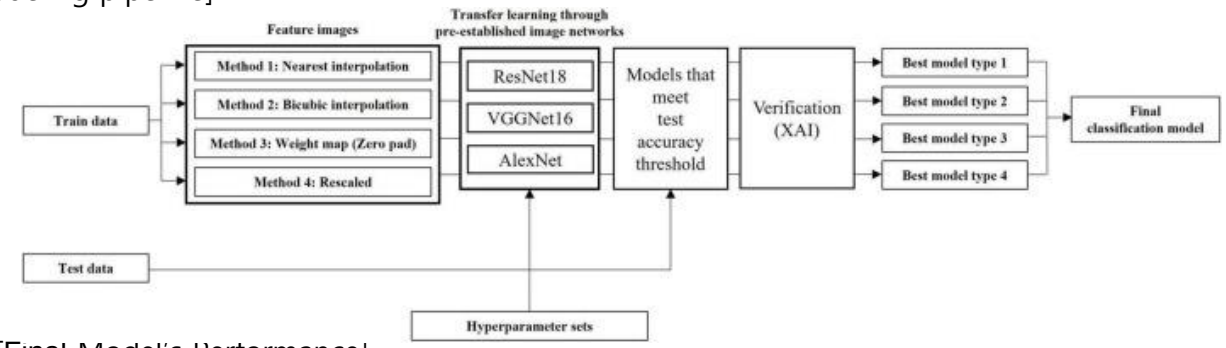
[Topographies' images of matrices]

Novel Feature Image(Relative power Z-score) **Topographies (Relative power Z-score)**



Build a new feature image that complements the strengths and weaknesses of PSD and Topomap.

[Modeling pipeline]



[Final Model's Performance]

18-layer ResNet

Models	Accuracy	Sensitivity	Specificity
1. Nearest	90.9%	85.7%	92.1%
2. Bicubic	93.5%	92.9%	93.7%
3. Weight map	97.4%	100.0%	96.8%
4. Rescaled	92.2%	92.9%	92.1%

Discussion

- Developed and validated images for using topography information in EEG data for deep learning algorithms.
- Deep learning algorithms using image data show high accuracy in sorting out Alzheimer's disease dementia (ADD).
- It is expected to play an important role in the screening, diagnosis, and treatment of various neurological disorders by utilizing deep learning algorithms using QEEG feature images.