E-Poster

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Cognitive Impairment Detection via Decoupled Representations of Multi-Modal Signals

Topic: Miscellaneous

Jianqing Li, Prof Bin Liu, Rui Feng

School of Biomedical Engineering and Informatics, Nanjing Medical University, Nanjing, China

BACKGROUND

Mild cognitive impairment (MCI) is recognized as an early stage of dementia, and early identification and intervention are essential for delaying its progression. However, current clinical diagnostic methods, such as neuropsychological assessments and imaging tests, are expensive, invasive, and unsuitable for large-scale community screening. Moreover, traditional paper-and-pencil tests come with high labor and time costs and suffer from significant inter-rater variability, making them impractical for rapid, widespread screening.

METHODS

To address these challenges, this study proposes a novel method for detecting cognitive impairments using audio-visual modalities. We developed a new Cognitive Multimodal Analysis Dataset, which includes audio-visual data tailored for cognitive impairment detection in elderly Chinese individuals. The proposed method incorporates a decoupled representation-based multi-modal fusion framework, which resolves issues of data redundancy and overlap by standardizing the decomposition representation trajectories. Additionally, we designed a modality-guided fusion mechanism to mitigate performance bottlenecks arising from single-modality data limitations. The method was validated using five-fold cross-validation on the dataset.

RESULTS

The proposed method demonstrated strong performance in classifying cognitive impairments, achieving 70.71% UAR (Unweighted Accuracy Rate), 74.54% WAR (Weighted Accuracy Rate), 74.58% WAF (Weighted F1 Score), and 77.06% AUC (Area Under the ROC Curve) in the classification task. These results highlight the effectiveness and reliability of the proposed method in distinguishing between healthy and cognitively impaired individuals.

CONCLUSION

This study provides an efficient, cost-effective solution for cognitive impairment detection in community settings. The proposed method, based on decoupled representations and multi-modal fusion, addresses key limitations of traditional diagnostic methods and offers a promising approach for large-scale screening of cognitive impairments, particularly in elderly populations.

Statement of Disclosures

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Corresponding Author:
Jianqing Li
School of Biomedical Engineering and Informatics, Nanjing Medical University, Nanjing, China
Email: binliu.njmu@gmail.com