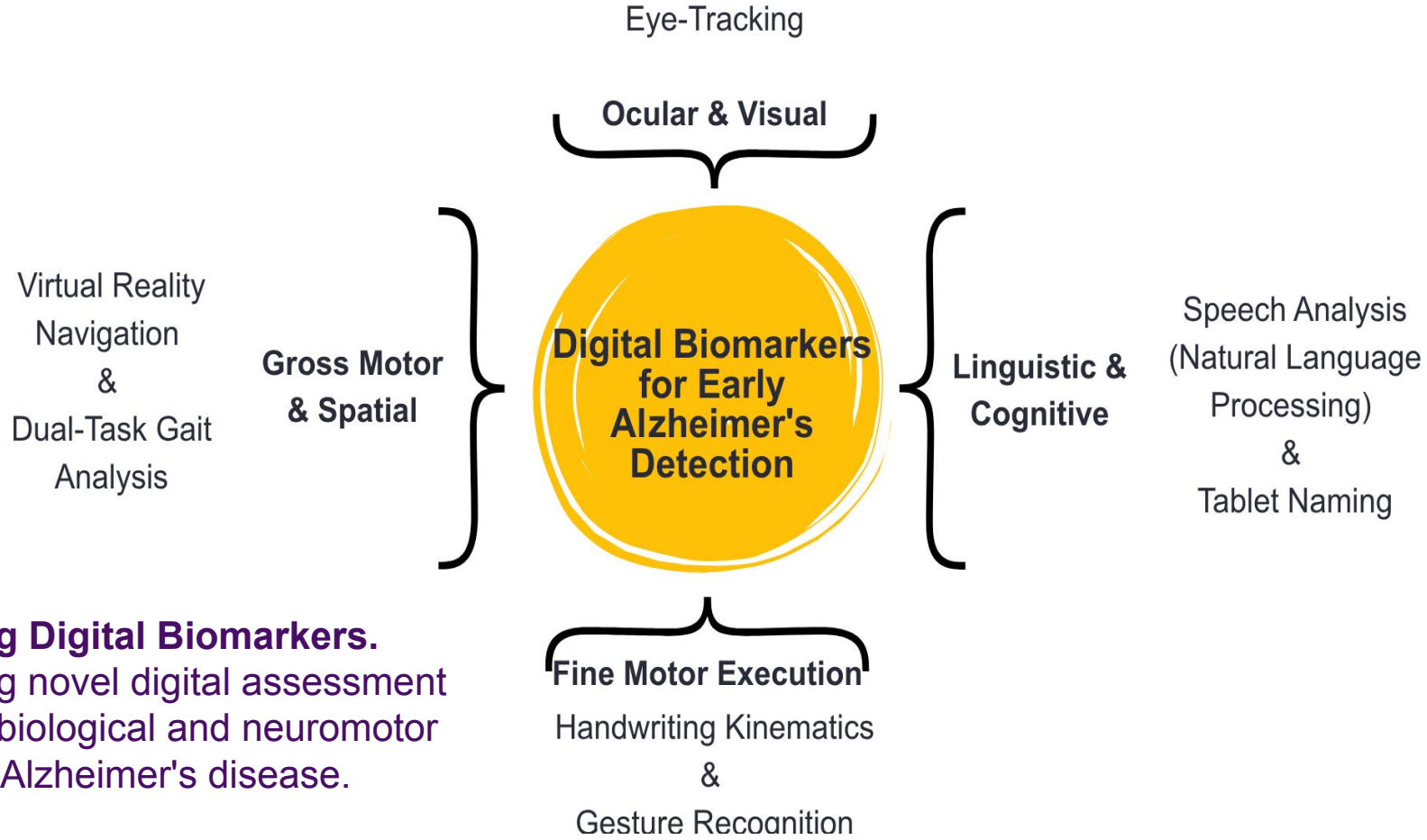


Emerging Digital Biomarkers For Early Detection Of Alzheimer’s Disease At The Primary Care Level

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Emerging digital technologies—including eye-tracking, Natural Language Processing, Virtual Reality, and kinematic sensors—provide highly sensitive, non-invasive, and objective methods for early Alzheimer's disease detection, significantly outperforming traditional static tests in primary care screening environments.

INTRODUCTION	RESULTS			CONCLUSIONS	REFERENCES																								
Primary care is the first line of defense for detecting Alzheimer's disease. However, traditional paper-based cognitive tests are limited by short consultation times, potential educational biases, and low sensitivity for detecting neurobiological changes in preclinical stages. Therefore, scalable, objective, technology-based alternatives are an urgent need for everyday medical practice to identify subtle cognitive and motor declines before severe dementia symptoms appear. The objective of this narrative review is to synthesize current evidence regarding the diagnostic accuracy and clinical scalability of emerging digital biomarkers in primary care settings.	 Figure 1. Taxonomy of Emerging Digital Biomarkers. Schematic representation mapping novel digital assessment tools to their corresponding neurobiological and neuromotor domains for the early detection of Alzheimer's disease. Table 1. Summary of Diagnostic Performance for Emerging Digital Biomarkers. A comparative overview of novel digital modalities, detailing their specific technological applications and corresponding clinical efficacy in detecting early-stage Alzheimer's disease. <table><tr><th>Study</th><th>Digital Biomarker</th><th>Main Finding</th></tr><tr><td>Eye-tracking digital marker</td><td>Eye movements</td><td>Best diagnostic performance (AUC 0.865), outperforming plasma biomarkers. Non-invasive and strongly associated with tau pathology. [1]</td></tr><tr><td>Speech & Language AI</td><td>Speech analysis (NLP)</td><td>Speech pauses, fillers and pronoun use identified early cognitive decline (AUC 1.0); vocabulary richness was protective. Promising low-cost screening tool. [2]</td></tr><tr><td>Handwriting biomarkers</td><td>Digital handwriting</td><td>Reduced tasks from 25 to 14 while improving accuracy (79.5 →81.0%) and reducing computation by 40%. Maximum accuracy: 94.2%. [3]</td></tr><tr><td>Virtual Reality navigation</td><td>Spatial navigation in immersive environments</td><td>Mild Cognitive Impairment participants exhibited significantly greater spatial disorientation, showing an average linear deviation of 100.4 meters compared to 38.2 meters in healthy controls. [4]</td></tr><tr><td>Dual-task gait</td><td>Wearable gait sensors</td><td>Dual-task walking improved prediction; AUC 0.801 (MCI) and 0.923 (dementia). Up to 90% prediction accuracy. [5]</td></tr><tr><td>Hand gesture recognition</td><td>Hand movements + AI</td><td>CNN/RNN/LSTM model achieved 90% accuracy (static images) and 87% (video), supporting gesture analysis as a digital biomarker. [6]</td></tr><tr><td>Tablet picture naming (MULES)</td><td>Tablet cognitive testing</td><td>Similar discrimination to MoCA and MMSE (AUC 0.77) with higher sensitivity (97–100%), making it useful for early MCI screening. [7]</td></tr></table>			Study	Digital Biomarker	Main Finding	Eye-tracking digital marker	Eye movements	Best diagnostic performance (AUC 0.865), outperforming plasma biomarkers. Non-invasive and strongly associated with tau pathology. [1]	Speech & Language AI	Speech analysis (NLP)	Speech pauses, fillers and pronoun use identified early cognitive decline (AUC 1.0); vocabulary richness was protective. Promising low-cost screening tool. [2]	Handwriting biomarkers	Digital handwriting	Reduced tasks from 25 to 14 while improving accuracy (79.5 →81.0%) and reducing computation by 40%. Maximum accuracy: 94.2%. [3]	Virtual Reality navigation	Spatial navigation in immersive environments	Mild Cognitive Impairment participants exhibited significantly greater spatial disorientation, showing an average linear deviation of 100.4 meters compared to 38.2 meters in healthy controls. [4]	Dual-task gait	Wearable gait sensors	Dual-task walking improved prediction; AUC 0.801 (MCI) and 0.923 (dementia). 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The primary barrier to immediate, widespread clinical integration is the current heterogeneity of digital platforms and the lack of unified diagnostic cut-off points across modalities like dual-task gait analysis and hand gesture recognition. Future longitudinal studies across diverse primary care populations are imperative to standardize these digital protocols, validate diagnostic thresholds, and seamlessly transition these tools from experimental frameworks into everyday medical practice.	- Ling Y, Sun P, Wang C, Peng G, Wang Y, Zhou X, et al. A novel eye-tracking digital marker outperforms plasma biomarkers in detecting cognitive impairment. <i>Alzheimers Dement.</i> el 8 de marzo de 2026;22(3):e71253. doi:10.1002/alz.71253 PubMed PMID: 41795668; PubMed Central PMCID: PMC12967584. - Filippis RD, Foysal AA. 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METHODS	A narrative review (2020–2026) of PubMed, Scopus, Web of Science, and Google Scholar was conducted using terms like “digital biomarkers of Alzheimer's disease” and “primary care screening”. From 22 initial records, 7 peer-reviewed studies were included. This review synthesized the reported diagnostic accuracy and clinical scalability of these emerging digital technologies. Literature Search (2020–2026) - Databases: PubMed, Scopus, Web of Science, Google Scholar - Keywords: "digital biomarkers of Alzheimer's disease", "primary care screening" Initial Screening - Records identified and screened for relevance (n = 22) Final Inclusion - Peer-reviewed studies meeting criteria for diagnostic accuracy & scalability synthesis (n = 7)																												
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