

Comparative Analysis of Centralized and Federated Learning Approaches for Smartwatch-Based Stress Detection

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Abstract: *The growing prevalence of stress-related disorders has driven research into automated stress detection using wearable devices. Smartwatches, with multimodal sensors, enable continuous, non-invasive monitoring. This study compares three learning paradigms—individual, centralized, and federated learning—using logistic regression on the WESAD dataset. Individual learning achieves the highest accuracy (99.9%) through personalization, centralized learning generalizes well (93.5%) but compromises privacy, while federated learning balances privacy and performance (85.7%) by avoiding raw data sharing. A review of twelve peerreviewed studies highlights common challenges, including small sample sizes, limited personalization, and lack of real-world validation. The findings suggest that federated learning is a promising approach for privacy-preserving stress detection. Future research should explore deep learning within federated frameworks, larger and more diverse datasets, and adaptive personalization to enhance accuracy and ethical data use. These steps will support the development of scalable, secure, and user-centered stress monitoring systems in healthcare and wellness contexts.*

Keywords: stress detection, Wearable devices, Smartwatches, Federated-learning Centralized learning, Individual learning, Data privacy

