PsycheMAP: A Novel Approach to Quantifiable Psychiatric Disorder Diagnosis Using EEG and a Hybrid CNN-BiLSTM Framework

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Psychiatric diagnosis remains largely subjective, with diagnostic agreement rates as low as 65% for major conditions. This research addresses the lack of quantifiable biomarkers in psychiatric diagnostics by developing PsycheMAP, the world's first AI-driven multi-disorder diagnostic tool that processes electroencephalogram (EEG) data to identify disorder-specific neural signatures across 16 psychiatric disorders. A hybrid deep learning architecture combining Convolutional Neural Networks and Bidirectional Long Short-Term Memory networks was implemented to process EEG data from 945 patients. The model utilized two complementary data representations: wavelet-based features for CNN analysis and raw EEG signals for BiLSTM temporal modeling. Power Spectral Density and Functional Connectivity analyses were conducted to identify disorder-specific neural patterns. Model performance was evaluated using 10-fold cross-validation. PsycheMAP achieved 96.3% overall accuracy in distinguishing between 16 psychiatric disorders, significantly outperforming traditional clinical assessment methods (46-60%) and existing machine learning models. The highest accuracy was observed for PTSD (97.5%) with bipolar disorder showing the lowest accuracy (85.3%). Feature importance analysis revealed that alpha and beta frequency power bands were most significant for diagnostic classifications. PsycheMAP demonstrates that EEG-based neural signatures can serve as objective biomarkers for psychiatric diagnosis, transforming traditional subjective assessment into quantifiable science. The system's high accuracy, interpretability, and computational efficiency make it a clinically viable tool with potential applications in personalized treatment planning and longitudinal monitoring of psychiatric disorders.

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