Cracking the Seizure Code: A Deep Learning Approach to Neonatal Seizure Detection Utilizing Hybrid Architecture for Multi-Scale EEG Analysis

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This study explores the effectiveness of Convolutional Bidirectional Long Short-Term Memory (Conv-Bi-LSTM) in detecting neonatal seizure activity using Electroencephalogram (EEG) data, based on expert neurologist diagnosis. In an infant's critical first moments, the intricacy of their brain makes it difficult to distinguish abnormal patterns like seizures, which can strike without warning and have devastating effects. Given the critical need for timely seizure detection in neonatal intensive care units (NICUs), traditional methods, which often rely on professional analysis, can be slow and less effective in early detection. Machine Learning offers promising solutions to address these challenges in neonatal seizure detection. This study involved a publicly available dataset with 79 term neonates, in which 20 infants were randomly selected. The 20 EDF files were then processed through bad signal removal, band-pass filtering, fixed-length epoch segmentation, Principal Component Analysis, standardization, and temporal duplication. To enhance infant seizure detection, the model was trained on entropy-based and wavelet decomposition features, resulting in a strong performance. The model was able to universally qualify the individuals and obtain an overall accuracy of 86%. Out of all 20 neonates, the model could accurately predict 90% of the non-seizure activity and 76% of the seizure activity. Thus, this study determines the potential of Conv-Bi-LSTMs in accurately detecting neonatal seizures based on EEG data, showing promise for reducing the long-term impacts and improving outcomes for vulnerable neonates.

Awards Won: