

Convolutional Neural Network-Based Temporal Prediction of Subdural Haemorrhage on Computed Tomography

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Subdural haemorrhage (SDH) is a life-threatening condition requiring timely assessment to monitor its progression. While computed tomography (CT) imaging remains a primary tool for diagnosing SDH. But accurate prediction of its temporal changes remains challenging, especially in identifying sub-acute SDH. This study aims to develop a convolutional neural network (CNN) model for predicting the temporal progression of SDH by leveraging Hounsfield Units (HU) to estimate the age of SDH, aiming to improve diagnostic accuracy and support clinical decision-making for better patient outcomes. CT slices were sourced from the RSNA Intracranial Haemorrhage Detection dataset. Slices with clearly represented haemorrhages were selected and categorised into acute (HU > 55), sub-acute (HU 25–50), and chronic (HU 10–20) SDH by investigators under radiologist supervision. A CNN was developed using 825 pre-processed CT slices, divided into a 70:30 train-test ratio, along with a separate 150-slice validation set, ensuring balanced representation across all SDH stages. The model was implemented in Python on the Google-Colab platform. Model performance was evaluated using standard metrics, including accuracy, sensitivity, specificity, precision, F1-score, Dice Similarity Coefficient (DSC), Intersection-over-Union (IoU), and Area-Under-the-Receiver-Operating-Characteristic-Curve (AUC-ROC). The model achieved 83.11% training accuracy and 85.33% overall accuracy. Sensitivity for acute, sub-acute, and chronic SDH was 86.67%, 84%, and 85.33%, with specificity values of 94%, 88%, and 96%. Precision scores were 87.84%, 77.78%, and 91.43%, while F1 scores were 87.25%, 80.77%, and 88.28%. Excellent segmentation performance was demonstrated, with DSC values of 87.25%, 80.77%, and 88.28%, and IoU values of 77.38%, 67.74%, and 79.01% across the respective stages. AUC-ROC values ranged from 0.9394 to 0.9731 across five-folds, reflecting robust classification performance. In conclusion, the model effectively predicts the temporal progression of SDH with high accuracy, sensitivity, and specificity. These findings significant implications for improving diagnostic accuracy and treatment planning in SDH management. The research contributes to current understanding by leveraging artificial intelligence to automate and enhance CT scan analysis, providing a more reliable tool for clinicians.

Keywords: Subdural haemorrhage, computed tomography, convolutional neural network, python