FedHeart-MM: A Privacy-Preserving Federated Multimodal Framework for Accurate Heart Disease Prediction

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Presented The 6th International Electronic Conference on Applied Sciences

Background: Currently, in medical analysis, the mortality rate is enhanced due to cardiovascular diseases. WHO reports that approximately 17.9 million people are afflicted with heart diseases, which leads to death across the globe. Cardiovascular diseases are illnesses that affect the heart and blood vessels, including cerebrovascular disease, coronary heart disease, rheumatic heart disease, etc. **Objective:** In this article, our objective is to predict early heart disease using deep learning. We designed a framework that addresses the critical gaps in heart disease prediction, as well as ensuring privacy, clinical utility, and equity. **Materials/methods**: We used several classification models, such as LogR, RF, XGBoost, 1D-CNN (Centralized), LSTM (Centralized), FedAvg (EHR Only), FedHeart-MM, FedHeart-MM + DP (ε=2) to predict early heart disease. We proposed a novel framework called FedHeart-MM to achieve this task. The FedHeart-MM architecture was designed to facilitate distributed training among several client nodes while maintaining the confidentiality of raw patient data.The federated configuration enables each client (e.g., hospitals or data centres) to conduct local training on their data while transmitting just model parameters to a central server. **Result:** This study's proposed model, FedHeart-MM achieved 95% AUC-ROC, sensitivity of 92%, specificity of 93%, and an F1-score of 82%. In comparison to another model, our proposed model performs well and identifies early heart disease. We also observed that there is a 14% higher AUC vs. our traditional approaches. Federated models exhibited enhanced privacy-preserving capabilities.