Age and Sex estimation with Deep Learning from a 12-Lead ECG

Development of the neural network model and comparison of results with an existing model

Graduate Candidates

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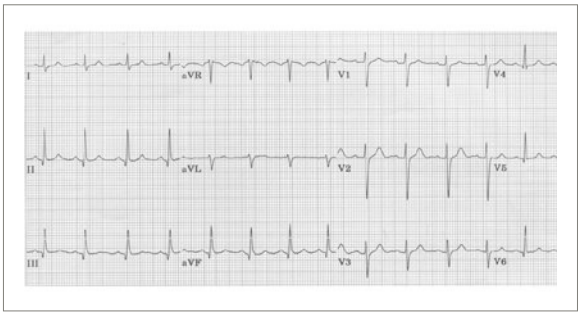
Introduction: The electrocardiogram (ECG) is widely used in medical practice today. It takes a lot of experience and special attention to detail to interpret its signals. The ECG provides valuable information for healthcare professionals about the condition of a patient's heart and helps to diagnose cardiovascular diseases. It is known that sex and age have an influence on ECG signals. Normally, it is the task of an experienced physician to interpret such data, but it is known that neural networks can also be successfully used, for example, to estimate patient age and sex. An existing neural network model was used as a basis. Our task was to design a new one and compare its performance with the previous one using data from multiple public ECG databases.

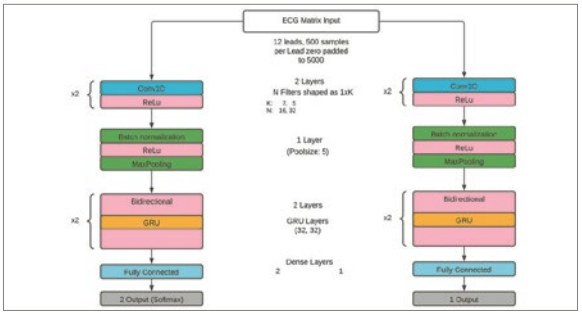
Approach / Technology: The models were programmed in Python using the TensorFlow 2.0 and Keras frameworks. Since the ECG signals are from different public online sources and contain different parameters, a pre-processing function was created to prepare all signals with the same sampling frequency and length. In addition, data augmentation techniques were implemented to improve model performance. The existing model, a Convolutional Neural Network (CNN), was trained and evaluated with the provided public data. To improve model performance, other model architectures were created and tested, such as ResNet, LSTM, etc. The final model chosen, which outperformed, was a hybrid with CNN layers and bidirectional GRU layers.

Result: With the available data, the existing CNN model did not perform as well as the results obtained by the creators of the model. However, this performance comparison should be interpreted with caution because the ECG data are different. Regarding the model proposed, on the test data, an accuracy of 80.5% was achieved for the sex classification, and results with an average deviation of 7.16 ± 2.2 years for age regression.

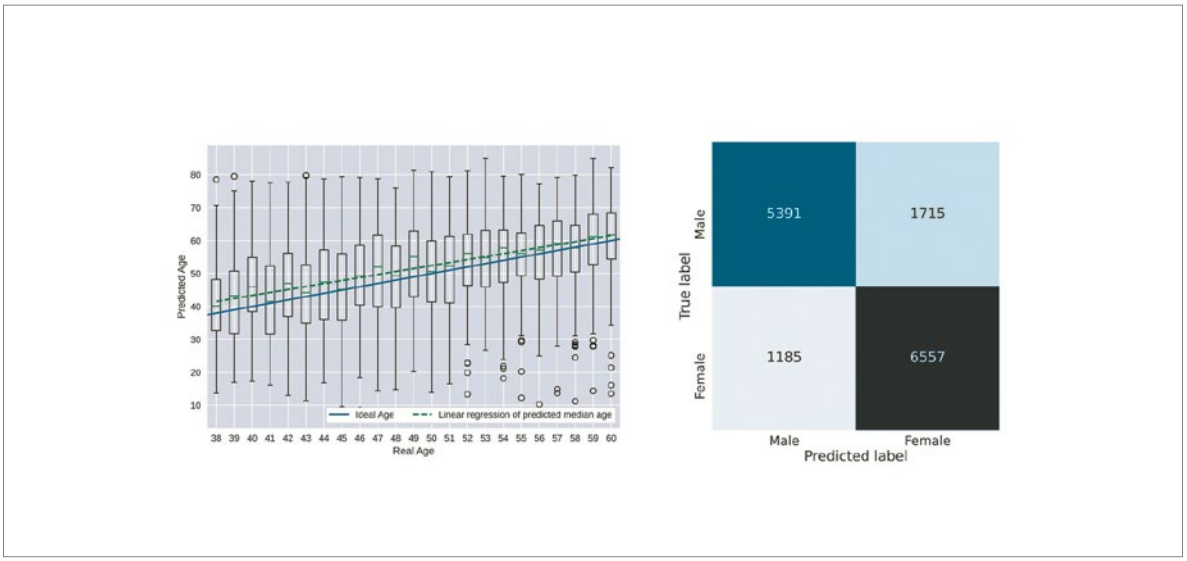
Standard 12-lead ECG signal
https://ecg.utah.edu



The proposed model with better performance
Own presentment



Outcome of age and gender predicted by the best model for the test data
Own presentment



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Subject Area
Artificial Intelligence