PPG Signal-Based Classification of Blood Pressure Stages Using Wavelet Transformation and Pre-trained Deep Learning Models

This study proposes a novel approach for utilizing photoplethysmography (PPG) signals for cuffless blood pressure (BP) measurement using deep learning models. Despite the potential of PPG signals for non-invasive BP measurement, difficulties arise due to the variability of PPG signal traits among individuals. This work suggests a new categorization technique using continuous wavelet transforms and pre-trained deep learning models (transfer learning techniques) for classification. The suggested method classified PPG signals into four classifications: normal, pre-hypertension, hypertension stage 1, and stage 2. The proposed approach for PPG signal classification is based on deep learning models. The model was trained using a medical dataset of 219 individuals to classify blood pressure. The model was implemented by fine-tuning deep learning networks (InceptionV3, Vgg16, ResNet101, and EfficientNetB7) separately and then comparing them to detect the best one. The work was examined using a variety of stable and robust performance metrics, including F score, specificity, recall, and accuracy, all of which exhibited values around 94%. The performance of the four models is compared as shown in the following table. The Inception V3 provides more robust performance metrics in comparison with VGG16, EfficientB7, and ResNet 101. The results showed that the model is highly accurate at classifying the different blood pressure stages and demonstrates its feasibility which can serve as a foundation for further study. Despite the small size of the dataset used, the study demonstrates the potential for improving model accuracy through processing and fine-tuning deep-learning models. Future studies will consider the size of the dataset and the usage of different processing transformations that can affect the model's performance. The trained pre-trained model's tuning and number of layers will also be investigated. In conclusion, this work offers a promising method for using PPG signals to assess blood pressure without an intrusive procedure. The model performs better than traditional models for classifying hypertension stages and exhibits excellent accuracy. Further studies can build on these results to improve non-invasive blood pressure testing methods.

	VGG16	InceptionV3	EfficientNetB7	ResNet101
ACC%	22.00 +/- 2.144	94.3 +/- 8.497	79.69 +/- 6.43	89.30+/- 17.78
SPF %	22.00	94.25	79.75	89.50
SEN %	16.25	94.25	79.00	90.00
F1-Score %	17.5	94.00	78.75	89.25