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Constructing a Blood Pressure Device Calibration Model Using Big Data Analysis and AI Algorithms

Kuo-Hao Chang
Professor at Department of Industrial Engineering and Engineering Management
National Tsing Hua University, Hsinchu, Taiwan, ROC
chang@mx.nthu.edu.tw

Min-Syuan Wu
Master's student at Department of Industrial Engineering and Engineering Management
National Tsing Hua University, Hsinchu, Taiwan, ROC
wu112034559@gapp.nthu.edu.tw

Abstract

Hypertension is one of the leading causes of death worldwide, making blood pressure prevention and monitoring critical issues. With the rise of smart wearable devices, smart blood pressure monitors are gradually replacing traditional ones due to their convenience. This study aims to develop a calibration-free blood pressure prediction model using electrocardiogram (ECG) and photoplethysmogram (PPG) signals, thereby eliminating the need for cuff-based calibration in smart blood pressure monitors.To address the problem of insufficient practical data, this study adopts a transfer learning approach. Initially, a pre-trained blood pressure model is established using the publicly available MIMIC-III dataset. Subsequently, a small amount of practical data is used to fine-tune the model. Methodologically, the pre-trained model employs a ResNet deep learning model, achieving a mean absolute error (MAE) of 3.60 for systolic blood pressure (SBP) and 2.97 for diastolic blood pressure (DBP). To enhance the effectiveness of transfer learning, this study proposes a novel transfer learning architecture called TL-SQEBPP (Transfer Learning-based Signal Quality Enhanced Blood Pressure Prediction Framework). This framework utilizes the ResNet deep learning model for blood pressure prediction and incorporates a signal selection model, AutoEncoder, to provide high-quality input. The results demonstrate that this method performs excellently, with the final model achieving an MAE of 4.9 for SBP and 4.19 for DBP on practical data.

Keywords
Blood pressure estimate, Deep learning, Transfer learning, Wearables.