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Machine learning approaches to estimating BMI from a small set of photographs

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Abstract

Body Mass Index is a common anthropometric tool for screening obesity. Instead of direct measurement, it may be useful for public health research, screening, and intervention to perform screening from common photographs. Machine learning models are used to predict body mass index from controlled photographs in a relatively small dataset consisting of 161 unique participants. Deep learning with convolutional neural networks are compared and outperform feature engineering based machine learning by approximately an order of magnitude on unseen test data, with high correlation between predicted and actual values with greater than 0.94 correlation coefficient and a mean absolute error of 1.20. Given the small set of unseen test data, data augmentation techniques are then explored: the use of automatically generating the image set from source images and combining it with the original set yielding an approximate 2 % improvement on average correlation values; and a new technique called "validation bootstrapping". This technique enables the entire model to be trained with equivalent performance from a subset of as few as seven source images with performance similar to training with a regular set with 44 or more images.