ActiNet: Improved Activity Recognition in Wrist-Worn Accelerometers

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Human activity recognition (HAR) using wearable accelerometers has become a key tool for understanding activity behaviours during daily living. In both consumer and research settings, HAR models can interpret raw accelerometer data into meaningful activity categories, ranging from sleep to vigorous activity, which can then be associated with health outcomes. Accurate and reliable activity recognition models are therefore crucial for advancing smartwatch-based activity monitoring and health research.

This work introduces a newly developed activity intensity recognition model, ActiNet (pypi:actinet), that is compared with an existing model, Accelerometer (pypi:accelerometer) [1]. ActiNet uses a modified ResNet-18 V2 model [2], pre-trained through self-supervised learning [3], to classify 30-second windows of wrist-worn accelerometer data, followed by hidden Markov model (HMM) [4] smoothing. In contrast, pypi:accelerometer extracts a suite of signal features from 30-second windows and classifies them using a balanced random forest, also followed by HMM smoothing. Both models were trained and internally validated on the Capture-24 dataset [5], the largest collection of activity-labelled, free-living, wrist-worn accelerometer data. External validation was conducted using two publicly available datasets collected during activities of daily living.

The pypi:actinet model consistently outperformed pypi:accelerometer model in classifying activity intensity labels across internal and external validation. In internal cross-validation, ActiNet achieved a mean (± standard deviation) per-participant macro F1 score of 0.83 ± 0.11, as compared to 0.77 ± 0.11 for pypi:accelerometer. This performance improvement was consistent across age and sex-based subgroups of Capture-24, as well as in external validation datasets.

These findings support the adoption of pypi:actinet as a reliable tool for extracting labels of activity intensity from wrist-worn accelerometer data in future research.

References

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