A Windowless Approach to Recognize Various Modes of Locomotion and Transportation

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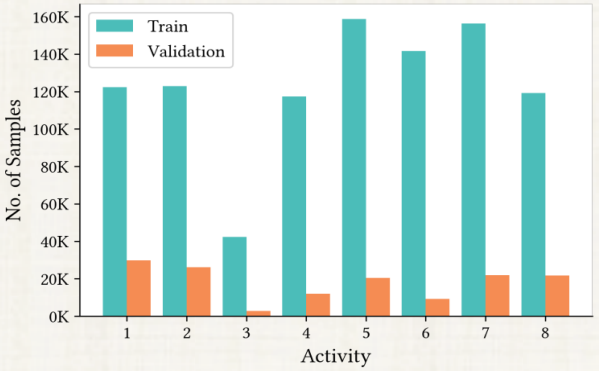
Abstract

"SHL recognition challenge 2021" is an activity recognition challenge that aims to detect different modes of locomotion and transportation based on radio data. We exploited a classical machine learning based approach and achieved 93.4% accuracy and 89.6% F1 score on the training set using 10-fold cross-validation, as well as 62.3% accuracy on the provided validation set.

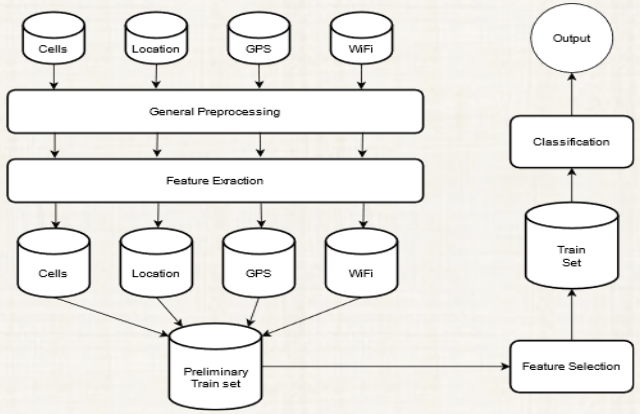
Background

The dataset for the SHL recognition challenge 2021 consists of eight modes of locomotion and transportation activities in a user-independent manner based on radio data, including GPS reception, GPS location, Wi-Fi reception, and GSM cell tower scans. There are eight activities in total, and they are still, walking, run , bike, car, bus, train, subway. Figure 1 shows the distribution of those activities.



Method

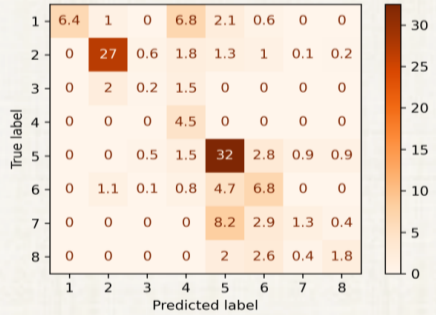
We opted for classical machine learning methods for the "SHL recognition challenge 2021". In this dataset, the average sampling rate was close to 1Hz, which is very low and there were a large amount of missing data. So, we opted for a windowless approach instead of the traditional windowed approach. Figure 2 depicts the summary of our methodology.



We have done 10-fold cross-validation on four different models, namely, K-Nearest Neighbor classifier, Random Forest classifier, Extra Trees classifier, and XGBoost classifier, and used the best model to predict on the validation set. Not all features are related to the goal of the challenge. Our model might learn unnecessary details from redundant and irrelevant features that do not apply to generalized cases. This may lead to overfitting our model too quickly. That's why we made use of different feature selection techniques that helped us get rid of features with negative impact.

Results

We used three decision-tree based models and one nearest neighbor model to evaluate which model works best on our method. We used 10-fold cross-validation and found out the Random Forest model gives the best result in the dataset with an accuracy of 93.4%. On the validation set, it obtains an accuracy of 62.3%. The confusion matrix obtained is provided in figure 3.



Conclusion

In our work, we have taken radio data collected with smartphones and extracted statistical features to train on different models. Among them, the Random Forest classifier performed the best based on 10-fold cross-validation result.