Smartphone Location Identification and Transport Mode Recognition using an Ensemble of Generative Adversarial Networks

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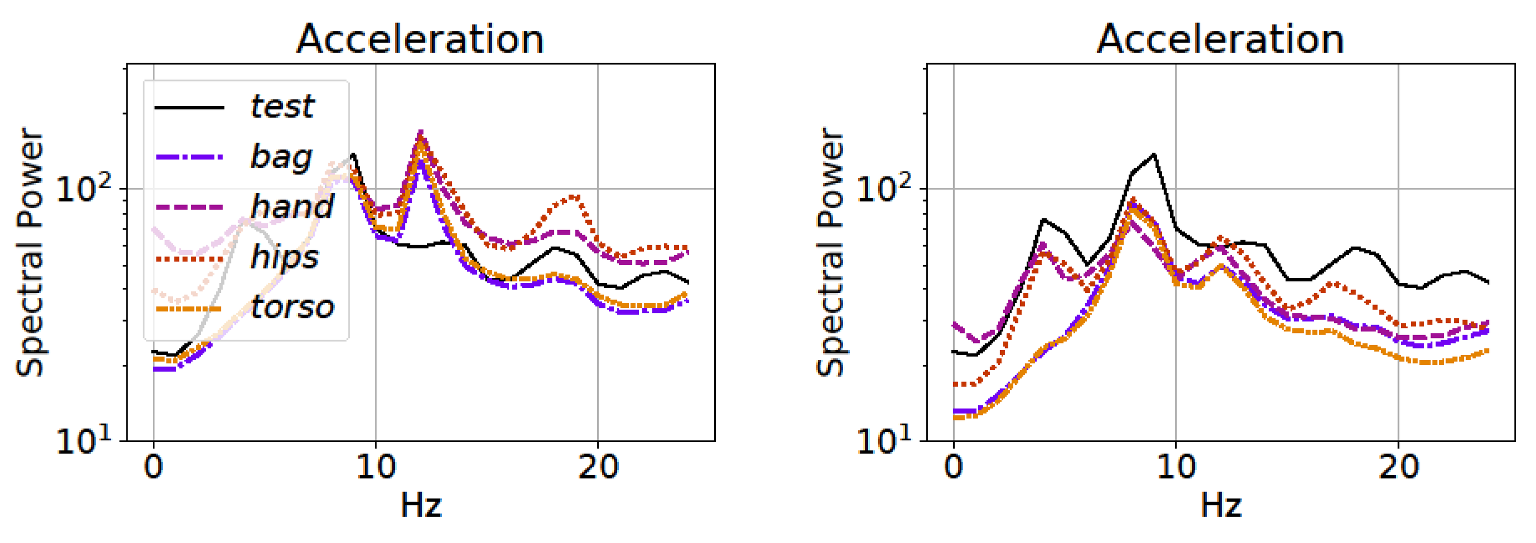
Location Identification

Frequency Domain Similarity



(a) X_{Train} **(b)** X_{Val}

Figure 1: Comparing the acceleration spectrum of the *Test* data to known locations.

- Computed average power spectrum of the acceleration magnitude across all windows in each subset
- 5 out of 6 users identified 'Hips' as most similar graph

Feature Space Similarity

- Calculated mean feature vector across all windows of a location-specific subset
- Normalised each feature between 0 and 1
- Calculated the Euclidean distance between the test vector and a subset vector

Location	Bag	Hand	Hips	Torso
Distance (Train)	6.02	6.39	4.85	5.02
Distance (Val)	6.39	5.27	5.15	6.31

Outcome

- '**Hips**' was identified as target location
- Other training and validation data was dropped

Transport Mode Recognition

Generative Adversarial Networks (GANs)

- Architecture inspired by SenseGAN [1]
- Generator G creates synthetic data samples
- Discriminator D tells real data-label pairs ($[X_L, Y]$) from fake ones ($[X_U, \tilde{Y}]$; $[\tilde{X}, Y]$)
- Classifier C predicts label $\tilde{Y}$ for
  - Labelled training and validation data (X_L) and is trained on actual label Y
  - Unlabelled test data (X_U) and is trained based on discriminator feedback
- Adversarial training and utilization of unlabelled data aim to improve classification performance

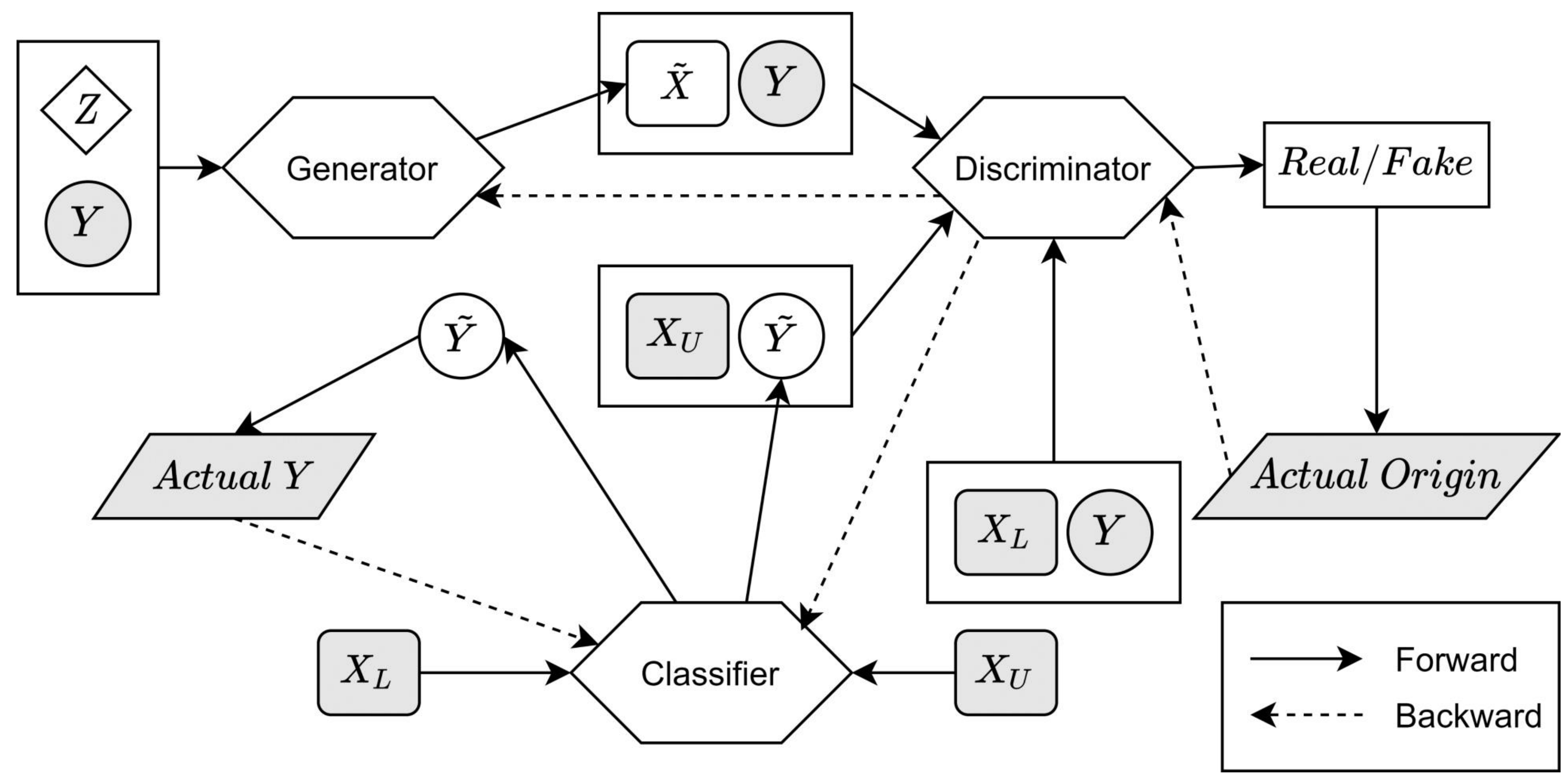
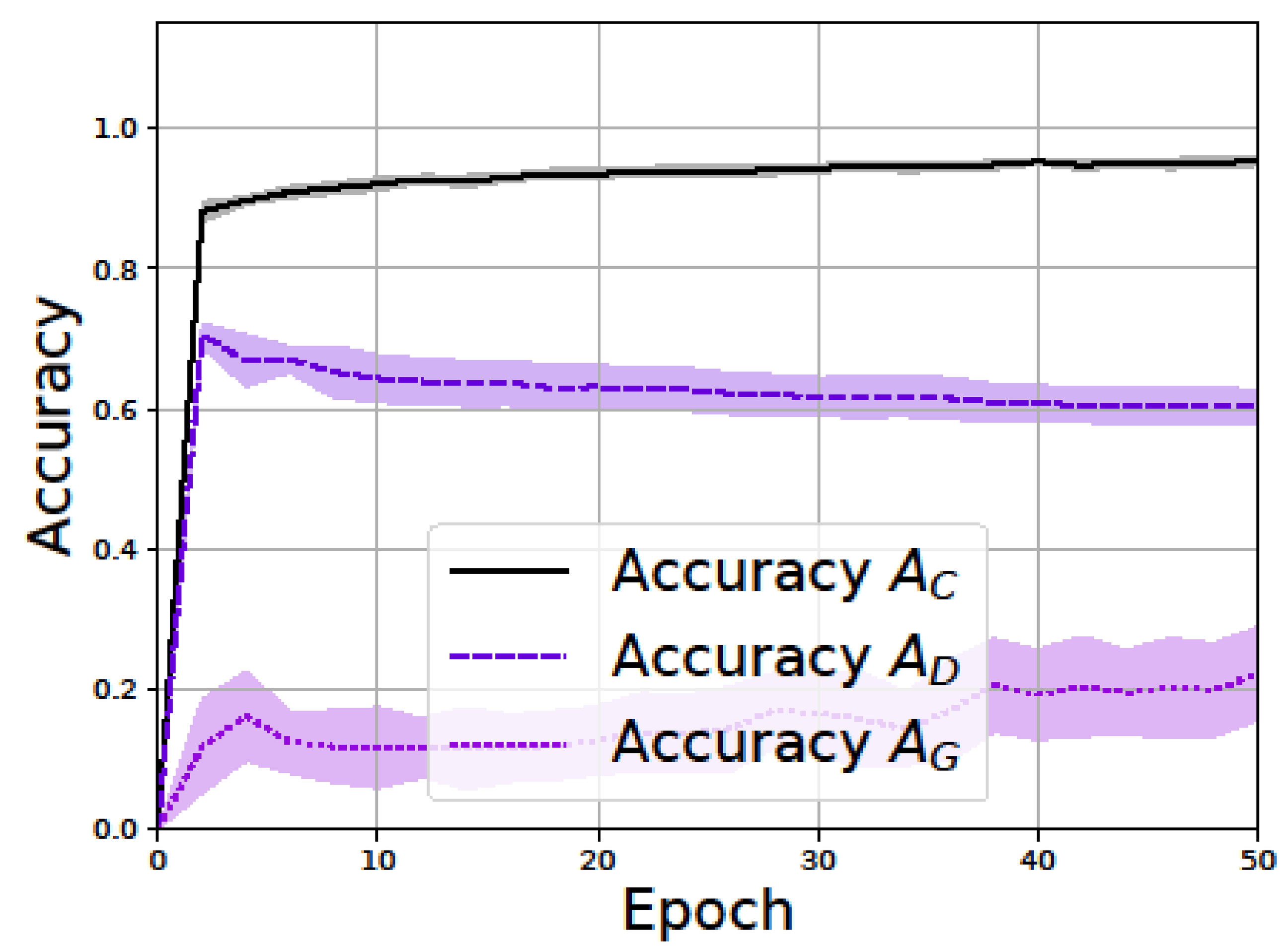


Figure 2: The GAN architecture used to improve classifier performance

Results

- SMOTE oversampling applied to validation data
- Classification Accuracy A_C is evaluated on validation data
- 25 epochs of initial training on training data (Classifier only)
  - A_C = 50.1%
- 50 epochs of complete GAN training with validation data as labelled data and test data as unlabeled data
  - A_C = 95%
- 95% is our expected accuracy for the test data



References

[1] Yao, S., Abdelzaher, T., Zhao, Y., Shao, H., Zhang, C., Zhang, A., Hu, S., Liu, D., Liu, S., Su, L., et al.: SenseGAN: Enabling deep learning for internet of things with a semi-supervised framework. Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 2(3), (2018) 1–21

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