Verification of the Relation between Clustering of Environmental Sounds and Accuracy in Ear Acoustic Authentication

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Keywords: ear acoustic authentication, t-SNE, clustering, visualization

Introduction: In recent years, biometrics, especially ear acoustic authentication which uses reflected sound from the ear canal, has been attracting a lot of attention. Robustness against external noise must be assured also in ear acoustic authentication. However, relation between authentication accuracy and external noise has not been fully investigated. In order to increase the robustness, it is necessary to know how noise is classified. We, therefore, experimentally investigate the relation between the environmental sound class and authentication accuracy in biometrics using acoustic signals by clustering environmental sounds.

Experiments: Short-time Fourier transform was performed on 19 different environmental sounds, rain, river, thunder and so on. Next, the amplitudes of each frequency were added to each other and averaged over the entire time. Then, the data were visualized by t-Distributed Stochastic Neighbor Embedding(t-SNE)[1], which is a dimension reduction algorithm, and a two-dimensional scatter plot was created. From the scatter diagram, the first to fourth classes were classified.

Results and discussion: Figure 1 shows classification result. The data were divided into four classes: class 1, class 2, class 3 and unclassified. The sounds of air planes, rain, river, and thunder do not appear to belong to any class. It can also be seen that the sound of opening and closing doors spans classes 1 and 2. We estimate that this result is because these sounds have the characteristics of multiple classes of sounds. It is possible that different classes may have different ear acoustic authentication results.
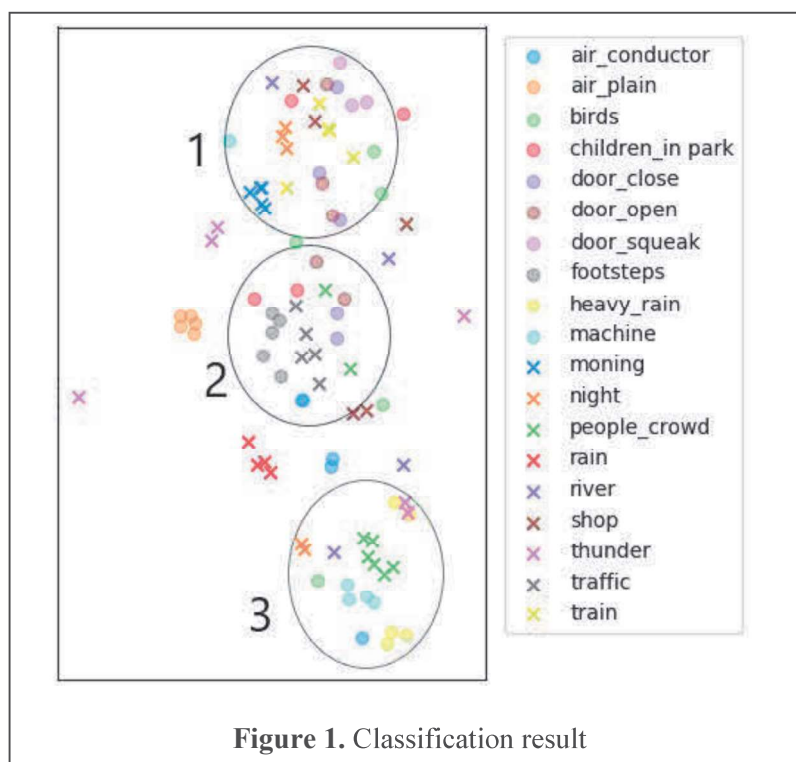

Figure 1. Classification result

References:

1. Laurens van der Maaten & Geoffrey Hinton, *Journal of Machine Learning Research 9*, **2008**, *77*, 2579-2605.