Counting people with audio volume data

Student

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Introduction: The objective of this project was to estimate the occupancy of a room based on audio volume data. The data was collected from two sensors over a 12-day period, from 7:00 to 16:00/17:00, with measurements taken at 30-second intervals, resulting in a total of 16,404 samples, as depicted in Figure 1. Initial analysis revealed a class imbalance, with a significant over-representation of occupancy values at 0, as visible in Figure 2, where about half of the data falls into this category. A similar pattern was observed in the volume data. Additionally, the occupancy data exhibited substantial noise. A moderate positive correlation was observed between occupancy and volume, as depicted in Figure 3, which shows a violin plot of occupancy and volume. In this plot, the red bars represent the means for single occupancies and the blue lines represent the 25% quartiles.

Approach: A range of algorithms were investigated and applied to predict the occupancy from volume data, employing techniques such as changepoint detection and other, non-linear methods.

Result: One model does not fit, and other models have difficulties distinguishing between 0 and 1 occupancy. Models not being able to differentiate 0 and 1 is understandable in this setup because one person usually does not make much noise without a conversation. The use of audio volume as predictor may be revisited. Other potential reasons for a moderate prediction accuracy could be a weak relationship between the feature volume and the target occupancy. It is also important to consider the potential influence of external factors on the results, such as machinery or noise outside the room. Further methods or measures could be researched for this problem.

Alternate potential ways for enhancing prediction accuracy include more data, using a less noisy occupancy variable and a higher sampling rate.

Figure 2: Barplot of occupancies
Own presentment

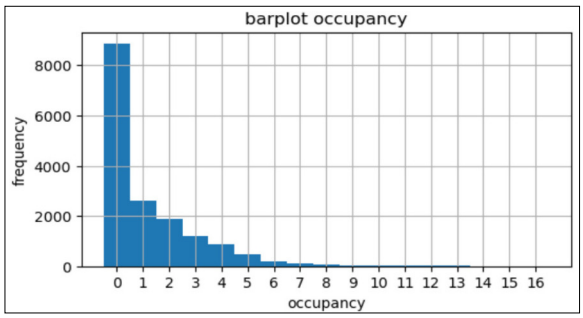


Figure 3: Violin plot of the volume distributions over the occupancies.
Own presentment

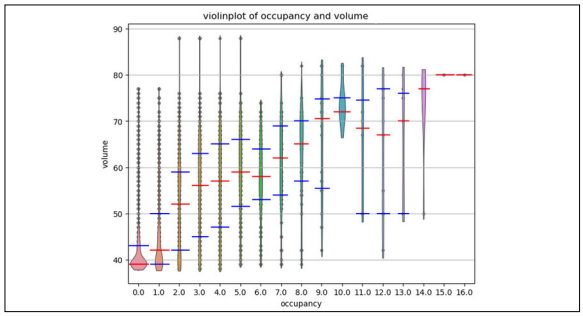
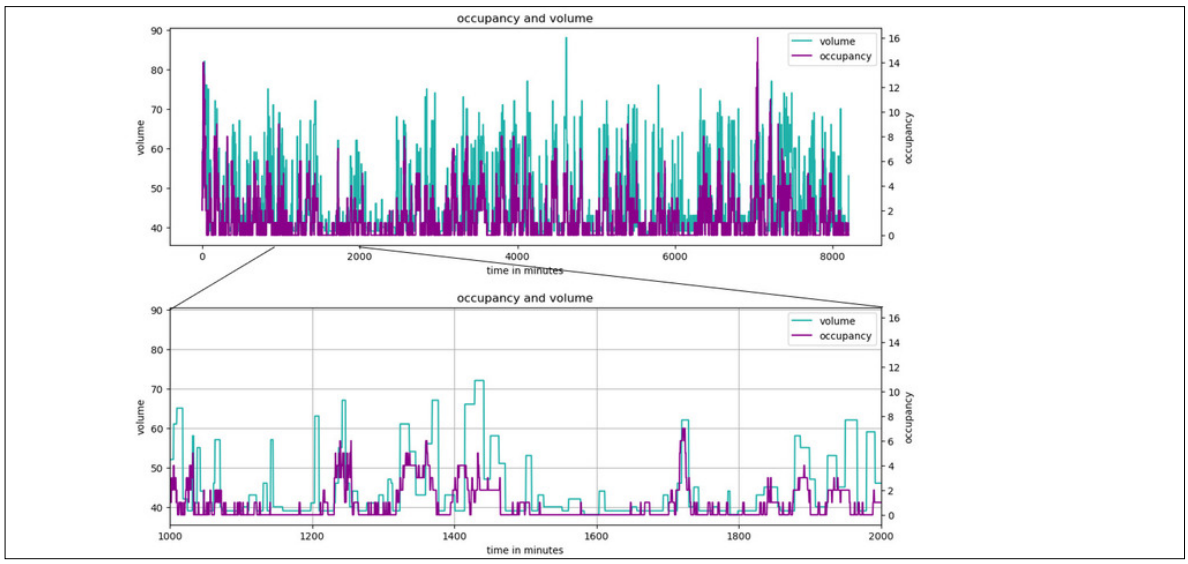


Figure 1: Audio volume and occupancy plotted and a zoomed in version at the bottom.
Own presentment



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Subject Area
Data Science

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