Estimating Caloric Intake in Bedridden Hospital Patients with Audio and Neck-worn Sensors

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Methods

Feature Extraction
- We extracted 34 features from audio for each second. Then we calculated the average and standard deviation of the 34 features across 5 seconds centered at each second, resulting in 68 audio features.
- We extracted 98 features from the proximity, ambient-light and LFA signal as shown in the table.

Food Type Identification
- Apply Random Forest Classifier (RFC) (n=100 trees) to classify food-type consumed by second based on the features extracted from audio and necklace sensors.
- Apply Leave One Food Out (LOFO) evaluation method to identify food-type.

Calorie Estimation
- Select the top 5 features using the forward feature selection algorithm out of the 166 combined features, for each food-type.
- Develop Multiple Linear Regression (MLR) model for each food-type to map second-level features to calories per second.
- Apply LOFO evaluation method to estimate kCals.

Results

Food Type Identification
- The average F1-Score is 98.8% using the necklace-only model, 94.0% using the audio-only model, 97.2% using the combined model.

Calorie Estimation
- For each second, we calculate the calorie using the corresponding regression model and achieve a 3.0 kCal Absolute Error, and a 96.6% accuracy on average.

Conclusions
- We show, given a limited number of known food items provided to a bedridden participant the ability to identify food-type with 97.2% F1-Score, and estimate calories with a 96.6% accuracy using audio, proximity, IMU, and ambient-light sensors around the neck.
- Future work will incorporate testing in real patients in a hospital setting while consuming a greater variety of food items.