PILOT STUDY OF EXPLOITING ABDOMINAL SOUND FOR EARLY MEAL ONSET DETECTION

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Background and Aim:

- A typical artificial pancreas depends on continuous glucose monitoring (CGM) for insulin dosing.
- Because of the slow dynamics of the glucose sensing, current CGM based meal detection approaches typically exhibit a delay of 10 to 40 minutes between actual meal onset and reliable detection [1,2].
- In contrast, the processes of ingestion and digestion produce sounds even before meal glucose enters the blood. [3]
- Therefore, the focus of the present work is towards the early meal onset detection based on abdominal sounds.

Method:

- The sound signals are segmented into smaller segments each of 20 seconds with an overlap of 10 seconds between consecutive samples.
- Features: Mel-frequency cepstral coefficients (MFCC) and wavelet transform-based entropy features from each abdominal sound segment.
- The extracted features are combined by using simple feature concatenation technique to get a final feature vector representation.
- Classification: The final feature vector extracted from each segment is given to a feedforward neural network for discriminating meal and no-meal abdominal sounds.

Experimental results:

Leave one out cross validation with the following metrics:

I. TPM: Four consecutive sound segments after meal onset are classified as meal-sound
II. FPM: Four consecutive segments before the start of a meal are classified into meal-sound
III. FNM: If there are no four consecutive segments after the start of meal classified as meal-sound
IV. RD: The time delay from actual meal onset to the time of detection by the proposed method.

<table>
<thead>
<tr>
<th>Subject Number</th>
<th>TPM</th>
<th>FPM</th>
<th>FNM</th>
<th>RD</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Noise-free)</td>
<td>75%</td>
<td>25%</td>
<td>0%</td>
<td>6.6 min</td>
</tr>
<tr>
<td>(Noisy)</td>
<td>50%</td>
<td>50%</td>
<td>25%</td>
<td>2 min</td>
</tr>
</tbody>
</table>

This approach detects meal onset with an average delay of 4.3 minutes in our limited number of subjects. Importantly, it provides lesser delay than the state-of-the-art CGM based approach [1,2].

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References