Discriminative Accelerometer Patterns in Children Physical Activities

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INTRODUCTION: Physical activity (PA) plays an important role for maintaining healthy weight in children. Accelerometers are commonly used for estimating PA energy expenditure in free living settings. Many existing classification approaches (i.e. artificial neural networks) using accelerometer data identify PAs using feature representations of accelerometer counts such as major percentiles and correlation between counts to summarize a minute of data. Though these feature representations can summarize the data, they often overlook aspects of the inter-relationship between the individual count values.

PURPOSE: The purpose of this study is to detect patterns between neighboring 1-sec count values which are common in one particular PA but are rare in other PAs and propose a method which can detect discriminative patterns for different PAs.

METHODS: Seventy one children (age range: 8-12 yrs) participated in the experiment. PA was recorded using an ActiGraph GT3X+ 3-axis accelerometer and the vector magnitude was used in the experiments. Data were examined for two similar activities "Dance Dance Revolution" and "Workout video" with a duration ranging from 5-11 mins. For each possible time interval extracted from one activity instance, two kinds of supports were calculated: 1) positive support, the percentage that the subsequence existed in other instances of the same PA, and 2) negative support, the percentage that the subsequence existed in a different PA. When a subsequence has high positive support but low negative support, it is marked as a discriminative pattern for this PA, which has the ability of telling the difference between activities.

RESULTS: The best discriminative pattern found in "Dance Dance Revolution" lasts 50 seconds and has 69.4% positive support and no negative support. In "Workout video", the best discriminative pattern lasts 70 seconds and has 54.3% positive support and no negative support. This indicated 69.4% and 54.3% true positive activities can be accurately classified by examining the possession of these two patterns.

CONCLUSION: While this study only explored the most discriminative pattern per PA, other work in machine learning has shown that using multiple discriminative patterns for each PA may improve classification performance. The results indicate that when children perform the same activity, there are common patterns appearing in most of the cases and among these common patterns, there are some discriminative patterns which are rare or even non-existent in other activities. Further work in detecting these discriminative patterns can further assist in correctly classifying PAs.

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