Title: Improving Sensor-based Activity Recognition Using Motion Capture as Additional Information

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Abstract:

The paper proposes a new method for improving human activity recognition using a single accelerometer sensor in combination with additional sensors for training. The performance of inertial sensors in recognizing complex activities is often lower compared to simple activities due to similarities between different classes. The authors suggest using more sensors during training, but not during the actual recognition phase, to enhance performance. They introduce the concept of mapping test data to a codebook created from additional sensor information. The preliminary results, using the Berkeley MHAD dataset, demonstrate a positive impact on activity recognition, with a 10.0% improvement in both the average F1-score and average accuracy. The approach particularly benefits activities such as standing, sitting, and sit-to-stand, where the wrist-worn accelerometer is less informative.

Keywords:

- Activity recognition

- Inertial sensors

- Motion capture

- Clustering

- Additional information

ACM Classification Keywords:

H.1.2 \[User/Machine Systems\]: Human information processing

Introduction:

The introduction highlights that while inertial sensor-based activity recognition achieves high accuracy for simple activities like walking and sitting, it performs significantly poorer for complex activities. Existing approaches to improving accuracy involve using additional data from multiple sensors or sensing modalities. However, constraints such as cost, privacy concerns, and battery usage limit the practicality of using multiple sensors. The paper proposes a method that utilizes motion capture data only during the training phase to enhance activity recognition based on accelerometer data.

Proposal Description:

The proposed method involves several steps. First, motion capture data is used for unsupervised learning to create clusters of movements. Statistical features are extracted from subsequences of the motion capture data, and clustering is performed to generate a feature space. Next, supervised learning is employed using tumbling windows of motion capture data to train a classifier for activity recognition. The accelerometer data is then mapped to the cluster space by segmenting it into subsequences and predicting their belongingness to each cluster. Finally, activity recognition is performed by applying the trained classifier to the accelerometer data segments.

Experimental Evaluation:

The proposed approach is evaluated using the Berkeley Multimodal Activity Dataset (MHAD). The dataset contains 11 actions performed by 12 subjects, recorded using an optical motion capture system and wrist accelerometers. The data is divided into training and test sets, and various statistical features are extracted from both motion capture and accelerometer data. The affinity propagation algorithm is used for clustering, and SVM classifiers are employed for activity recognition and cluster learning. The evaluation results demonstrate improved average F1-score and accuracy compared to a traditional approach, particularly for activities with lower scores in the traditional approach.

Conclusion:

The paper presents a method for enhancing sensor-based activity recognition by incorporating motion capture data during the training phase. By mapping accelerometer data to a cluster space created from motion capture data, the proposed approach improves the accuracy of recognizing complex activities. The experimental evaluation using the MHAD dataset validates the effectiveness of the method.