Posture and movement recognition from locations of body tags

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Confidence project aims to prolong the independent living of the elderly by monitoring their movement and posture for early detection of medical and related problems. The users will wear a number of body tags whose locations will be detected by radio sensors. The paper presents methods for the reconstruction of body posture and movement from sensor locations and the first experimental results.

The postures considered are standing (or walking), sitting and lying. We also investigated three types of movement: sitting down, lying down and falling. They were chosen for the relevance to the project: the postures and the first two types of movement are the basis for further work, whereas falls are one of the most important events Confidence will detect.

The test subjects wore 12 tags on shoulders, elbows, wrists, hips, knees and ankles. This is the full complement of tags, which will later be reduced to determine the minimum number of tags required for adequate recognition of relevant behaviors. Tag locations were detected by highly accurate but expensive infrared motion capture equipment, since the Confidence radio equipment is still under development. To simulate the expected lower accuracy of the cost-efficient radio equipment, two degrees of noise were added to the obtained measurements.

Postures and movement types were recognized with machine learning methods. We recorded three test subjects performing the activities of interest. The recordings were used to train classifiers capable of recognizing new recordings as belonging to one of the six postures and types of movement. Different attributes characterizing posture and movement and different machine learning algorithms were tested. The attributes considered were the coordinates of tags and derived quantities in the absolute coordinate system, the coordinates of tags in a coordinate system attached to the user's body and the angles between body parts. The machine learning algorithms were C4.5 decision trees, RIPPER decision rules, Naive Bayes, k-Nearest Neighbor, Random Forest, Bagging, AdaBoost M1 boosting and Support Vector Machine. The highest classification accuracy was achieved by Support Vector Machine using absolute coordinates and angles between body parts as attributes. The results show that in some cases it is possible to recognize basic postures and movement types with over 95 % accuracy.