COMPARISON OF SENSOR CONFIGURATION IN TELE-HEALTH APPLICATIONS ON CLASSIFICATION OF BEHAVIOR

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INTRODUCTION

The effectiveness and success of tele-health services crucially depend on the ease with which clients can use and access the service. In the case of tele-monitoring applications in which clients must wear sensors, ease and comfort of use are compromised if the sensors must be tightly fixed to the body at precise points. Several studies (e.g. [1]) have shown that it is possible to reliably monitor physical behaviors of ambulant clients by means of accelerometers that are tightly attached to the lower part of the body. In this study we investigate to what extent reliable information about the behaviors can be obtained from accelerometers that are attached to the client's clothes, instead of to the body.

METHODS

We carried out experiments with five healthy subjects. Six Minimod 3-D acceleration sensors (Mcrobberts) were used to capture information about the behavior of the subjects. These sensors were split up into two sets; one set was tightly fixed to three body segments (both upper legs and the torso). The other set was attached to the clothing of the subject on corresponding sites (sensors were put in both pockets of the subjects' trouser and one was attached to the belt). The subjects performed a set of controlled movements and postures, viz. sitting, laying, standing, walking at four different speeds, walking up and down the stairs, and bicycling on a home trainer at four different speeds. In addition, a set of semi-natural activities were recorded, viz. sitting at a desk and working on a computer, reading in a chair without a table, playing a game of pictonary (while standing), bicycling outside, walking up stairs to fetch some item and a housekeeping task. The signals were exported to Matlab for further processing. We will use a two stage Hidden Markov Model (HMM) for the classification of posture and movement. In the first stage the posture of the body is predicted and in the second stage the movement of the body is predicted based on prior knowledge of the prediction in the first stage. Initial training and validation experiments with the first stage of the model are currently evaluated. The model is trained per subject. Future steps include training and validation of the whole model on both the body and clothes worn sensor sets.

RESULTS

The Initial training and validation experiments of the first stage of the model showed excellent results for both the body worn sensors and the sensors attached to the clothes. We observed no significant difference in performance between these sensor sets. In case of both sensor sets the test set is correctly classified for at least 95%.

DISCUSSION

The first stage of the model can be trained excellent on both sets of accelerometers. Hence, both sensor sets contain the necessary information for the classification of sitting, lying, and standing. The next step is to train and validate the full classification model on both sensor sets. We hypothesize that both sets will have comparable good classification results in this second step.

CONCLUSIONS

The acceleration signals from sensors worn in clothing are sufficient reliable for detection of postures in ambulant behavior monitoring applications.

REFERENCES

[1] Veltink, P.H.; Bussmann, J.B.J.; de Vries, W.; Martens, W.L.J.; Van Lummel, R.C. Detection of static and dynamic activities using uniaxialaccelerometers. Rehabilitation Engineering, IEEE Transactions on Volume 4, Issue 4, Dec 1996 Page(s):375 - 385