AUTOMATIC MONITORING OF ACTIVITIES OF DAILY LIVING USING A WIRELESS ACOUSTIC SENSOR NETWORK

L. Vuegen[1], B. Van Den Broeck[1], P. Karsmakers[1] and B. Vanrumste[1,2]

[1]KU Leuven, Dept. of Electrical Engineering (ESAT), Electrical Engineering Technology Cluster (ESAT-ETC), Advanced Integrated Sensing Lab (AdvISe)
Kleinhoefstraat 4, B-2440 Geel, Belgium
e-mail: lode.vuegen@kuleuven.be
Web page: www.kuleuven.be/advise

[2] KULeuven, iMinds Future Health Department/STADIUS
Kasteelpark Arenberg 10, B-3001 Leuven, Belgium
Web page : www.kuleuven.be/iminds

ABSTRACT

In 2060 26% of the EU's population will be older than 65 years [1]. This causes significant budgetary implications on today's elderly care facilities. Therefore, proactive measures must be taken to prevent rocketing costs and overcrowded facilities. A possible solution is to assist elderly to longer live safely at home by using modern information technology.

This research focusses on automatic home observation of alone living elders by using a Wireless Acoustic Sensor Network (WASN). Such networks consists of multiple so-called acoustic nodes each containing one or more microphones. These WASNs have the advantages that: a) they can be placed without any inconvenient cables, b) the nodes can be relatively small while maintaining large spatial sampling, c) spatial and multichannel filtering techniques can be applied network wide and c) the workload can be distributed over the different nodes.

In order to evaluate the proposed approach, a small residence was equipped with seven different acoustic nodes (each containing three linear spaced MEMS-microphones with an inter sensor distance of 2.5cm). In total, ten different activities related to the Katz Scale of independence (e.g. brushing teeth, toilet visit, preparing food, etc.) were simulated and recorded during a three day time span [2].

From this dataset, when a sound is detected features are extracted based on both the spectral properties (Mel-Frequency Cepstral Coefficients) and position of the sound sources (Steered Response Power). It is worth mentioning that only the spectral features are computed from the node receiving the acoustical data with the highest Signal-to-Noise ratio (SNR) while the position features are computed from all nodes. Evaluation of the classification algorithm is done by partitioning the data with a 4-fold cross validation into a training and test set. A Gaussian Mixture Model (GMM) with five mixture components and a full-covariance matrix was trained for each recorded activity. Promising initial classification results were achieved, i.e. 92±4% for the spectral features and 85±4% for the position features.

Future research will focus on the validation of the proposed method on a larger and real-life recorded dataset.

REFERENCES

[1] "The business of aging: commercial challenges and opportunities in ambient assistive living". Available [online]: http://www.netcarity.org

[2] S. Katz, "Progress in the development of the index of ADL", The Gerontologist, Vol. 10, pp.20-30, (1970).