N. MORA, G. MATRELLA, P. CIAMPOLINI. Behavioural analysis based on IoT home sensors. Gerontechnology 2018;17(Suppl):86s-87s; https://doi.org/10.4017/gt.2018.17.s.086.00 **Purpose** IoT sensors are becoming increasingly pervasive: besides supporting useful automation tasks (e.g. lighting), IoT home sensor may be repurposed to capture and model the behavioural patterns related to the house/building guests[1]. Combining information from different sensors may provide useful insights on users' habits and a numerical basis to detect meaningful trends and anomalies. This is, indeed, the aim of the AAL NOAH project2: daily activity of elderly people, living alone at their home, are monitored on a daily basis, looking for behavioural anomalies (e.g. variation in sleep patterns) which may be indicators or predictors of health issues. The main concern, in this case, is the large variability of habits, both from person to person and even for the same person at different times. This makes it almost impossible to rely on absolute references to assess anomalies: adaptive, self-learning approaches are to be used. In this abstract, we present a methodology to fuse multi-sensor information and automatically derive salient patterns. In particular, the NOAH system is able to infer customary patterns, even when multiple modes occur, and automatically detect deviations from known patterns. **Method** A typical NOAH sensor kit[3] consists of a toilet, bed, chair presence sensor, a magnetic contact (e.g. for front door monitoring) and a Passive InfraRed motion detector. Each sensor logs information on a per-event basis on a MySQL Data Base (DB). In order to model daily patterns, sensor data is resampled at regular intervals (e.g. aggregating activations within 30 min. time bins) and smoothed. Each sensor's daily activity can be represented as a curve, and then compared. In particular, a custom distance metric was engineered to produce good clustering results, linearly combining Euclidean, Cosine and DTW (Dynamic Time Warping) distances. Spectral clustering is applied to the computed distance matrix, keeping track of the silhouette score. Finally, all distance matrices (pertaining to different sensors) are linearly combined and weighted proportionally to the associated silhouette score. A final clustering is performed to determine clusters of similar daily pattern. All the curves in a cluster are then used to estimate, for each time bin, the median sensor activation, along with confidence intervals. **Results & Discussion** The above procedure was applied to bed and chair sitting patterns of a 78-year-old male, featuring no severe medical conditions. As shown in *Figure 1*, the clustering algorithm automatically recognizes two distinct "daily behavioural modes": one in which the person tends to sit on the chair for most of the afternoon (Cluster 0), and another one (Cluster 1) in which the person stays in bed right after lunch. Median presence probability is shown in bold solid lines, whereas thinner lines represent daily curves of the cluster. Both "modes" have to be considered as normal, this ruling out a simple, threshold-based anomaly-detection strategy. Curves from different periods can be compared with behavioural profiles not matching any known mode (beyond confidence intervals) being flagged as a possible anomaly. Despite the simple example at hand, it demonstrates the possibility of "learning" complex, multi-modal behaviours. This prospectively enhances the system perspicuity in detecting actual meaningful anomalies and may effectively support monitoring and caregiving practices.

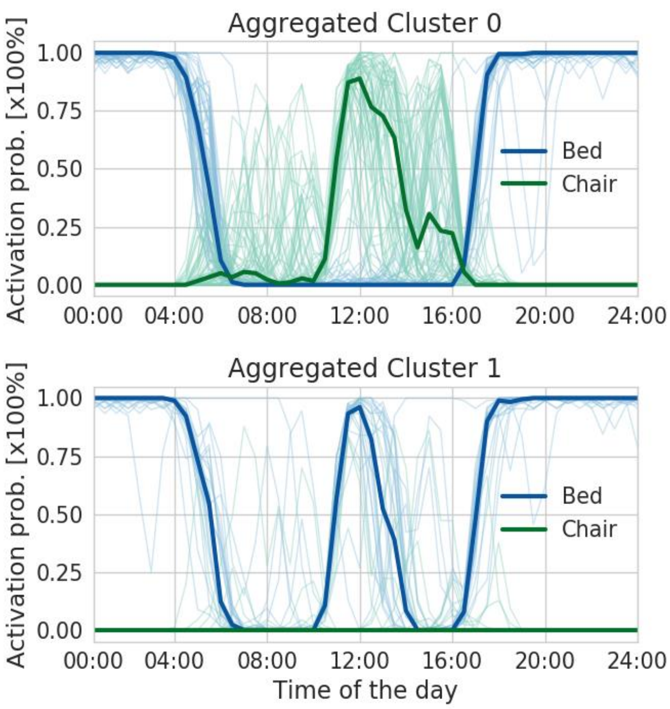

Figure 1. Automatically detected bed and chair activity clusters

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