V. Bianchi, F. Grossi, I. de Munari, P. Ciampolini. Wireless services in a home control system. Gerontechnology 2010;9(2):197; doi:10.4017/gt.2010.09.02.237.00 **Purpose** A wireless sensor platform has been integrated into the home control system CARDEA[1]. Wearable sensors are exploited for personal monitoring, whereas CARDEA deals with environmental control, thus effectively merging telemonitoring and home control into the same framework. Information coming from environmental and wearable sensors can be fused, enabling cooperative services. **Method** We developed a wireless sensor network architecture, based on the 802.15.4 / ZigBee protocol, which has profiles conceived for health and safety applications[2]. The mobile device embeds a transceiver, a microcontroller and a triaxial accelerometer. Functions implemented so far include fall detection and spatial location. To ensure usability, low weight, small size and low power consumption are needed. The power management strategy is twofold: (i) smart fall-detection algorithms have been devised (suitable for on-board processing and thus limiting the energy-demanding radio communication) and (ii) the implementation of a full, custom device, taking advantage of VLSI and MEMS technologies is being carried out. Fall detection algorithm relies on acceleration thresholds and posture changes[3] and is compatible with the power and computational resources of the mobile node. Both acceleration and posture (i.e. orientation) are extracted from the same accelerometer data stream, avoiding expensive and power-hungry gyroscopic devices. A prototype has been implemented using off-the-shelf components. The device includes a hardware location engine, which allows for inferring the wearer position and is used for monitoring wandering behaviours (e.g. people affected by Alzheimer disease or dementia). Much care has been devoted to power management, especially by exploiting available sleep modes. The belt-mounted prototype (*Figure 1*) weighs 76 g. A second-generation device is being implemented, based on the custom design of both the MEMS accelerometer and the VLSI data-processing engine. The System-in-Package approach we are pursuing should allow for drastic improvement of size, weight and power figures. At present, MEMS accelerometers, customized (full-scale, sensitivity, resolution) to the application at hand, have been designed, fabricated and tested. **Results & Discussion** The WSN has been tested in a laboratory environment. Satisfactory electrical performance has been obtained, extending the AA battery lifetime up to 40 days (24 hours/day activity). Volunteers have simulated falls and daily-living activities, allowing us to assess a 99.2% hit-ratio in fall detection, with only 1.3% false-positive alarms. When fall events are recognized, a call is issued to CARDEA, which may trigger coordinated actions (e.g. turn on the lights or release the door lock), warns caregivers in the home or dispatches alarm messages through the Internet (e-mail, twitter) or the phone line (vocal calls, SMS). A field trial is starting (1st quarter 2010) at a ~500 m^2 nursed home, which has been fitted with 20 ZigBee antennas, to provide 3D location and fall detection coverage over the whole facility.

References

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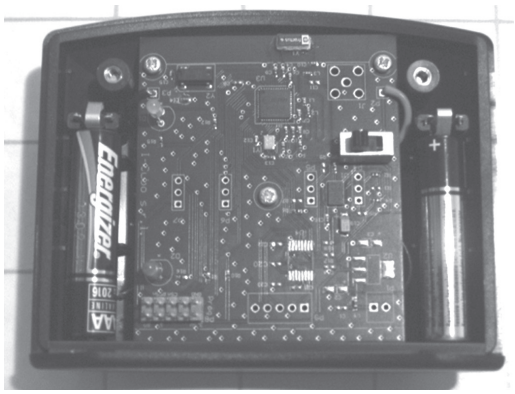

Figure 1. The wearable device