F. MONTALTO, V. BIANCHI, I. DE MUNARI, P. CIAMPOLINI. ***Detection of elderly activity by the wearable sensor MuSA****. Gerontechnology 2014;13(2):264;* doi:10.4017/gt.2014.13.02.354.00

Purpose As the population ages, there is a need for more care for the elderly, challenging health services and calling for tools supporting and integrating elderly care strategies[1]. Among ICT-based tools employed in the home to preserve autonomy and support independent life[2], a variety of fall detectors have been designed and are already available in the market. The most diffused solution relies on wearable devices embedding motion sensors; the sensor data stream can predict occurring falls and trigger suitable alarms. Motion data may be profitably utilized in a broader vision, including prevention. In fact, the sensor is usually worn all day; the data therefore embeds much richer information about the quality and quantity of the user's activity, which may be correlated to health status over time. In this work, new functions are implemented on the MuSA (Multi Sensor Assistant) platform[3], suitable for enabling behavioral profiling and long-term activity assessment. **Methods** MuSA is a lightweight, belt-worn sensor device, embedded with a MEMS (Micro Electro-Mechanical Systems) tri-axial accelerometer and a wireless transceiver, compliant with ZigBee/IEEE802.15.4 standards. The same microcontroller takes care of both the radio link management and of on-board data processing. To preserve battery lifetime, low-power design techniques and a careful energy budget planning have been taken into account. In order to minimize power hungry radio communication usage, data processing is kept as local as possible. The MuSA board has been completely redesigned, allowing for consistent savings on size, weight, and power consumption; as shown in *Figure 1*, the new device is small enough to be worn all day long with no significant burden. All features of its predecessor[3] (reliable fall detection, heart- and breath-rate acquisition capabilities) are retained, and novel functions oriented to behavioral assessment have been introduced. In this case too, activity and lifestyle indicators are inferred from the sensors data through local processing, dealing with computational resource constraints. Synthesized indicators can be inexpensively transmitted to a supervisor and fused with environmental data in a wider behavioral analysis scenario. MuSA is integrated in the CARDEA system, which includes modules for activity profiling and detecting abnormal behaviors[4]. **Results & Discussion** A first series of tests was conducted in a laboratory. In *Figure 2*, simple examples of processing outcomes data are shown: from the acquired acceleration components (a), MuSA discriminate among dynamic (i.e., moving) and static conditions (b), and provides information about trunk posture (c). A walk-analysis feature is implemented, providing quantitative measurement about walking speed and cadence. At the supervision level, fusion with physiological and environmental data will occur, providing a comprehensive view of the user's lifestyle in a non-invasive and inexpensive fashion. Field tests involving end-users are planned in the framework of the AAL-JP 'HELICOPTER' project.

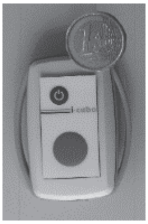

Figure 1. MuSA sensor

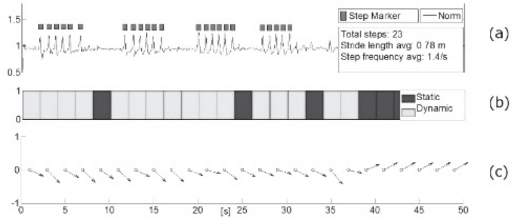

Figure 2. Behavioral indicator by MuSA processing; (a) walking step analysis; (b) dynamic/static behavior discrimination; (c) trunk posture

References

1. Salomon JA, Wang H, Freeman MK, Vos T, Flaxman AD, Lopez AD, Murray CJ. Lancet 2012;380(9859):2144-2162; doi:10.1016/S0140-6736(12)61690-0
2. Den Broek van den G, Cavallo F, Wehrmann C. AALIANCE Ambient Assisted Living Roadmap. Amsterdam: IOS Press; 2010
3. Bianchi V, Grossi F, De Munari I, Ciampolini P. Journal of Medical Imaging and Health Informatics 2012;2(1):70-75; doi.10.1166/jmihi.2012.1058
4. Losardo A. Gerontechnology 2012;11(2):330; doi:10.4017/gt.2012.11.02.492.00

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