Development of a motion sensing carpet

Purpose Changes in mobility level for older adults are highly related to the transition from relatively independent living to ill and declined functional health status. It is important to provide objective and accurate approaches for long-term mobility level assessment at home. Motion sensing floors have been developed for this purpose[1,2]. Considering user acceptance, the technology has to be unobtrusive, easy to use, low cost, and be a natural part of the home environment. This paper presents the development of 'WhizCarpet', a motion sensing carpet for tele-monitoring of mobility level, indoor locations and fall events in an unobtrusive way for older adults in the home environment. Multiple interactive applications are also developed based on this motion sensing carpet. **Method** WhizCarpet is composed of 30cm× 30cm 'puzzle floor mat' modular units, which can be assembled freely into any size and shape according to the setup of the home environment (*Figure 1*). Instead of adding sensing components to the carpet, the puzzle floor mat unit itself is designed into a motion sensor. The working principle is similar to that of a membrane switch. Once a WhizCarpet unit is under pressure, the top and bottom layers make contact with each other. Different pressure will create different contact quality and therefore generates different resistance (*Figure 2*). A low-cost microprocessor embedded in the unit converts the resistance into digital values (0-1023), and transmits it to a distributed data server (DDS) via I2C bus. The 'auto mapping' algorithm in the DDS automatically identifies the relative positions of all units assembled together. Integrated with information and communication systems, caregivers can maintain awareness of older adults' daily activities by using their mobile devices to access the DDS for real-time monitoring and historical data record. **Results & Discussion** WhizCarpet is in a 'Body and Brain' system structure which enables it to be an open platform. It can be used in not only home tele-heath applications but also multiple interactive applications, such as physical interactive games, by developing different Apps on the mobile devices (brain) which receives signals from the DDS of WhizCarpet (body). The product allows the user to modify or change Apps in order to change the interaction[3]. Considering aesthetics and emotionality, the 'Interactive vases' are also designed to provide more natural interaction between the older adults and the home environment and family members at remote sites. From the activities sensed by WhizCarpet, the vases display different rotation patterns, lights and music to provide interaction in an intuitive and visual way. The product is now in commercialization process.

References
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2. Lund HH. IEEE International Conference on Rehabilitation Robotics 2009;2(3):571-575; doi:10.1109/ICORR.2009.5209517
3. Lund HH, Marti P. In 18th IEEE International Symposium on Robot and Human Interactive Communication 2009;3(2):115-121; doi:10.1109/ROMAN.2009.5326286
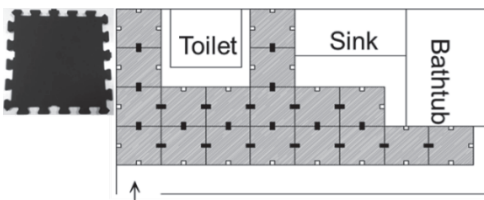
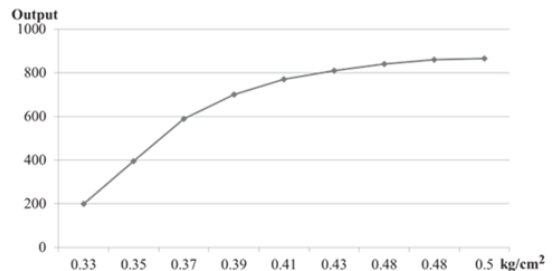*Figure 1. The 'puzzle floor mat' modular units that can be assembled freely into any size and shape*

Figure 2. Different pressure will generate different digital outputs