Developing a sensing solution to reduce the risk of falls

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Developing a sensing solution to reduce the risk of falls for older people: An interdisciplinary approach. *Gerontechnology 2014; 13(2):174;* doi:10.4017/gt.2014.13.02.173.00 **Purpose** Accidental falls by older people continue to be a major public health challenge that creates increasing personal and economic burdens as has been predicted because of the growth of an ageing population[1]. Since gait changes are a strong predictor of decline in lower extremity function in older people, detection of mobility changes could enable early intervention to prevent falls; this will provide support to allow older people to continue to live independently. Technological solutions used to identify how older people move and function in their own homes are needed to reduce personal and economic burdens. However, developing technology that is adopted by health care clinicians and at the same time proves useful for older people remains a challenge. To address this issue, an interdisciplinary work group comprised of engineers, health care professionals, care providers and older people was convened to guide the process of technological development. **Method** An iterative process was undertaken to create an engineering system that would meet the needs of end users including health and social care professionals, older people and families. In Phase 1, iMagiMat™ was developed using novel Guided Path Tomography[2] with polymer optical fibres embedded in carpet underlay; the underlay was equipped with peripheral electronics that sense and relay signals to a computer, allowing imaging as well as recording of the geometry and spatial location of each footfall[3] in real time. Phase 2 consisted of user involvement panels including, older people, some with dementia, family caregivers and clinicians[4] tasked with assessing the engineering system to ensure it meets the needs of end users in the following iteration of development. Phase 3 used the findings from the user groups to develop a demonstrator that enabled extraction of gait measurements that defined mobility, including footprint features and footfall patterns. This was followed by real-time imaging of the carpet surface deformation during walking by healthy volunteers. **Results & Discussion** The current iMagiMat™ demonstrator has optimised individual fibre sensors, tomographic sensor grid geometry and mechanical properties in the carpet underlay. At a current overall cost of materials ≈£100/m^2, it delivers video image frame rates of >30 frames per second with a spatial resolution of around 4.5cm. iMagiMat™ achieves this with fewer sensor elements and connections than seen in existing lab-based systems, enabling the creation of a manageable system, connected using a modular approach. Furthermore, it images small deformations on the carpet surface; these images can provide information on the dynamics of balance when standing or walking. Then, a series of interconnected iMagiMat™ 2×1m tiles can be flexibly applied to a variety of living scenarios. Further work is ongoing that is designed to characterise patterns that indicate joint mobility, symmetry and plantar pressure. Temporal (timing) and spatial (distance) parameters such as gait velocity, stride length, stride width, symmetry and cadence are also available for future data processing. iMagiMat™ looks and feels like a normal carpet capable of being installed or retrofitted into a person's own home to monitor movement or gait unobtrusively with the potential to identify health deterioration prior to an adverse event such as a fall. The interdisciplinary nature of this working group has ensured that each stage of development has been informed by the current and projected needs of clinicians, service providers, older people and families.

References

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