Impact Case Study

UoA 11: Computer Science and Informatics

A new product for creating annotated data sets within smart environments

Increasingly, many healthcare services are being delivered through home-based technologies, and a key element is the ability to assess the extent of a person's functional deterioration, particularly in many of the conditions that are associated with ageing. "Smart environments" enable sensor technologies, information and communication technologies, and adaptive interfaces to be combined to record people's movements and interactions with objects in their environment (for example, in the home or workplace). The purpose is often to conduct subsequent analysis to understand how people are behaving or coping with carrying out everyday tasks, and this analysis is based on automated recognition of the activities that a person is undertaking (for example, cooking, or eating). Within the smart environments research community, there is a lack of validated and annotated datasets, stored in a common format, that can be used to test and evaluate technologies that are developed for activity recognition. This is a well-recognised problem within the research and development community, both academic and commercial. Without such datasets, training and evaluation of automated activity recognition models are limited, which in turn leads to the development of methods for automatically recognising behaviour change being limited in terms of how well they can be generalised, scaled or transferred to other domains. Such methods are an essential part of technology-based approaches to assessing functional deterioration in persons with conditions such as dementia.

Researchers in the Computer Science Research Institute (CSRI) at Ulster are addressing this problem. Based on research in CSRI relating to data storage formats and activity recognition for applications within smart home environments, a European company developing high-precision medical devices has produced a new tool for data annotation. The company has developed a product that is used with a system of stereo-based cameras to record activities that people may carry out in a specified environment (for example, within the kitchen in their own home). Using the product these activities are then annotated (or labelled) to indicate what the person is doing (for example, preparing a meal, or washing the dishes). The new product has the ability to record user interactions with objects (for example, turning on a tap, lifting a cup, opening a door) within a smart environment and to synchronise recordings with data generated by other sensors (for example, notifications via contact or motion sensors of a door opening, a person moving, or a household object being lifted). This product has generated significant additional sales and revenue for the company, which has enabled the company to employ additional technical development staff to extend the product's functionality. CSRI has also established a formal Memorandum of Understanding with the company through which the product now supports automated annotation of activities that is based on CSRI's research on activity recognition.

For the past 10 years a core theme of CSRI research has been data collection and storage, coupled with automated activity recognition within smart environments. During 2003 CSRI developed and evaluated an approach for storage and exchange of electrocardiogram data through an XML-based approach. The output, referred to as ecgML, was the motivation for a subsequent approach developed for use within the smart environments research domain (homeML). HomeML provides a structure that enables all user-related data (activity levels, vital signs, object interactions), both within the home environment and beyond, to be stored in a common format. This format has been evaluated by researchers from 11 different international research centres during 2009-2012, and the evaluation results established the need to introduce the homeML concept more widely across the research community. HomeML is now freely available, and a repository where datasets can be uploaded/downloaded is also being promoted.

This research was also used to support Belfast City Council's successful £13.7M funding bid in 2012 to the NI Department of Culture Media and Sport's Urban Broadband Fund to position Belfast as a "super-connected city". As part of the bid CSRI provided supporting rationale in the form of Connected Health Case

Studies that would benefit the community if a super-connected city were to be established, demonstrating the significance of high-speed network access for remote monitoring of smart environments and automated recognition of activities taking place in those environments.

The award is enabling Belfast to become a world-class digital city, providing consumers with faster access to wireless broadband services throughout the city and growth potential for local industry.