An ICT Solution for Chronic Disease Self-Management: The SMART2 Project

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Introduction

Chronic diseases, such as stroke, chronic heart failure and chronic pain, can have a detrimental affect on the physical, emotional and mental well-being of individuals. This may subsequently result in unemployment, social withdrawal and an increased dependence on health and social care services [1]. In addition, the aforementioned chronic diseases are thought to be caused, maintained or exacerbated by behavioural factors [2]. In our work, we aim to develop a technological solution to self-management and behaviour change for sufferers of these three chronic conditions.

Materials and Methods

The SMART2 project (Self-management supported by Assistive, Rehabilitation and Telecare Technologies) is researching assistive technologies that will facilitate home-based self-management of chronic diseases [3]. The system aims to monitor daily activities, both inside and outside of the domestic environment. We have adopted a user-centred design approach in order to elicit requirements for, develop and evaluate a Personalised Self-Management System (PSMS).

The overall core infrastructure of the PSMS includes a server with a central database, touchscreen PC and smartphone. Depending on the condition, additional sensors are available. Figure 1 shows an overview of the PSMS system architecture.
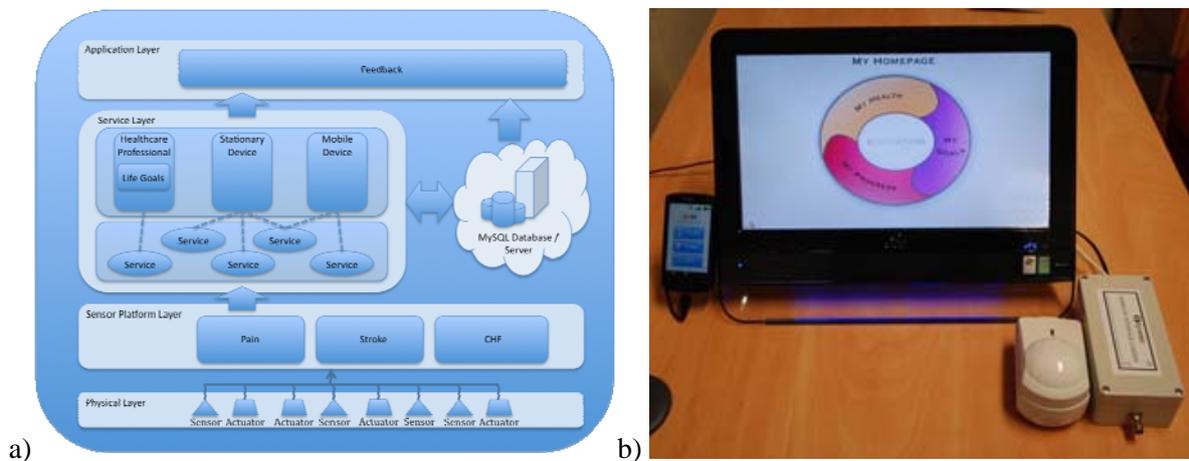

Figure 1: (a) Overview of the PSMS, comprising of the dataflow from sensor to server and server to database, (b) Second iteration of PSMS prototype containing smartphone, touchscreen and PIR sensor and receiver.

Both indoor and outdoor physical activities can be monitored and recorded for all three chronic conditions in addition to facilitating self-reporting of (depending on the condition), mood, pain, vital signs and sleep patterns. Quality of movement is a core component of the stroke PSMS, whereas safe quantities of movement are the main focus of CHF and pain.

The PSMS has the ability to analyse data collected and provide the end-user with real-time, personalised and motivating feedback, in addition to providing the necessary communication channels to healthcare professionals and information sources. Figure 2 shows the presentation of two modes of motivational feedback to the end-user, in the context of daily activity. Figure 2a shows the real-time feedback given during and on completion of a goal-orientated activity through a smartphone based platform. Figure 2b shows a summary of gross activity as presented on the stationary device located within the patient's home.
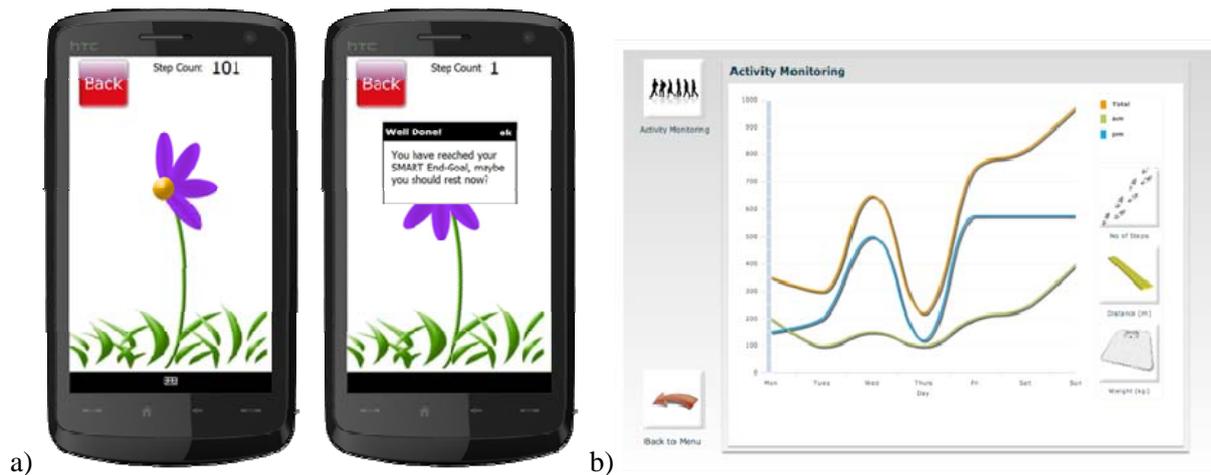
Figure 2: Examples of motivational feedback, (a) on Smartphone during and on completion of daily activity, (b) summative activity feedback on touchscreen PC.

Data collection is supported using a number of different modalities, such as self-reporting along with a sensorised home environment containing PIRs, door, pressure and bed sensors. Outdoor physical activity can be recorded using a smartphone with an in-built accelerometer to monitor gross movement whilst also acting as a pedometer. This is coupled with the smartphone's ability to receive and store its GPS location.

Results

User requirements were elicitated from a series of focus groups with healthcare professionals from each of the three chronic conditions. Each focus group consisted of 5 to 11 healthcare professionals. These focus groups were part of a three-phased iterative process consisting of assessing user needs, technical development and user evaluation. At present we are in the latter stages of technical development of a second iteration of the CHF prototype, and early development of the second iteration of the stroke prototype. To date a user evaluation of the UI has been carried out to ascertain the usability of the stationary (touchscreen PC) and mobile (smartphone) components of the system.

Discussion

In our work we have developed a PSMS to support those people suffering from long-term chronic diseases. Our work has been driven by a user centered design approach which has resulted in a number of iterations of prototype design, development and evaluation. Prototypes to support pain, CHF and stroke have been developed and have been evaluated in varying degrees by end users and healthcare professionals. To enhance the long term autonomy of the system a decision support module is currently in development to facilitate the automated provision of feedback relating to a specific end-user's health care plan. Additional future work will consist of the integration of a sensorised insole for monitoring of quality movement for end-users with stroke, whilst providing real-time feedback via the smartphone.

Acknowledgements

References

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