

Self Management of home rehabilitation using innovations in sensor and communication technologies: The SMART stroke study.

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Sheffield
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SHARPENS YOUR THINKING

The SMART consortium

Sheffield Hallam University: therapists and
project management

University of Ulster: computer informatics

University of Essex: engineering

University of Bath: medical physics

Stroke Association: access to stroke patients


Funded by the Engineering and Physical
Sciences Research Council (EPSRC) £700 K



Why self-management?

“as long as the acute care model dominates health care systems, health care expenditures will continue to escalate, but improvements in populations’ health status will not.”

WHO
Geneva 2002



A 2006 European Commission report has suggested that *'the way healthcare is presently delivered has to be deeply reformed... The situation is becoming unsustainable and will only worsen in the future as chronic diseases and the demographic change place additional strains on healthcare systems around Europe.'* They call for a *'new healthcare delivery model based on preventative and person-centred health systems. This new model can only be achieved through proper use of ICT, in combination with appropriate organisational changes and skills.'*

Policy Drivers

- 'NHS Plan' (2000) New funding model. Payment by results. Reduced length of stay.
- 'Our Health our care our say' (2006) Prioritised self management for long term conditions using technological innovations.
- 'Innovations for Health' (2007) Acceleration of use of medical devices.
- 'Darzi Review' (2007) Suggests personalised care, choice and personal control.

Scientific rationale for stroke self-management

- Targeted rehabilitation shown to promote re-organisation of the CNS
- Intensity and frequency improves functional outcomes
- Active participation and engagement shown to promote recovery
- Motivation is an important determinant of Rehabilitation outcomes
- Use of interactive technology can be used to change behaviour

What is Self-management?

- Key processes:
 - » Creer and Holroyd, 1997, Lorig and Holman, 2003.

Goal selection

- SMART systems must have library of exercises linked to goals

Information collection

- SMART systems must enables collection of kinematics and usage data

Decision making

- SMART systems must enable user to make choices

Problem solving

- SMART systems must enables user to analyse movements

Self-reaction

- SMART systems must enables user to respond to their analysis and change the movement pattern

Self-management and self-efficacy

Self efficacy one of key factors responsible for improvement in health following a self-management programme.

Jones, 2006, Lorig et al 1999

- Sources:
 - Mastery experiences
 - SMART systems must give confirmation of task success
 - Vicarious experiences
 - SMART systems must enable comparison of normal movement
 - Verbal persuasion
 - SMART systems must enable verification of achievement by significant other, professional or carer
 - Physiological feedback
 - SMART systems must allow intrinsic and extrinsic feed back

SMART Study

- Purpose:

Our consortium therefore needed to explore the use of innovative technologies to promote the self management of progressive, repetitive, functional tasks activity that motivates a stroke person to engage in the rehabilitation process.

SMART consortium embedded in User design

“Systematically and rigorously finding out what people want and need from their services is a fundamental duty of both the commissioners and the providers of services. It is particularly important to reach out to those whose needs are greatest but whose voices are often least heard.”

Our Health, Our Care, Our Say. Dept of Health
(2006)

SMART home rehabilitation project for people who have had a stroke

Year 1

Scoping exercise of existing technologies & analysis of evidence base

Movement templates with CODA system, upper limb, stroke, normal subjects.

User group engagement
• Focus groups with stroke survivors, carers, MDT.
16 users and carers
8 therapists

Year 2

Develop algorithms for MT9 data

Rendering of CODA data for user interface

PROTOTYPE I

- User group engagement 15 users and carers
- Test clothing for sensors
- Test interface.

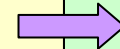
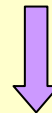
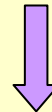
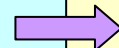
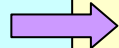
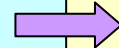
Year 3

Rendering of data from MT9 sensors change to MTx sensors.

User interactions with computer interface & development of user work book n=20

**PROTOTYPE II
SMART 1**

Home testing
4 case studies
Therapist Focus group



Patient and carer engagement Year 1

Any device should be:

- compact, simple to operate and maintained by staff in the event of problems
- usable by stroke patients preferably without the help of the carer to encourage independence
- available alongside the work of therapists
- able to give encouraging feedback to patients about outcomes even when progress is slow

Stroke Professionals Engagement Year 1

Any device should:

- Give feedback on quality of movement
- Give real time and summative feedback
- Be flexible enough to allow for normal variations in movement
- Emphasise functional movements
- Not be a substitute for a therapist but an adjunct

User centred design

Year 2



- To attach sensors to the wrist and arm
- To ensure accurate placement
- Comfortable fit for patient
- Easy to put on independently
- If possible, one size to fit all
- To be as simple as possible

User and carer engagement Year 2

- Wanted to see their movement in comparison with a target movement
- Wanted display of previous exercises to check progress
- Suggested both a split screen and superimposed display
- Wanted facility for adding notes
- Comfortable with the idea of remote monitoring



Diary entry successfully saved!



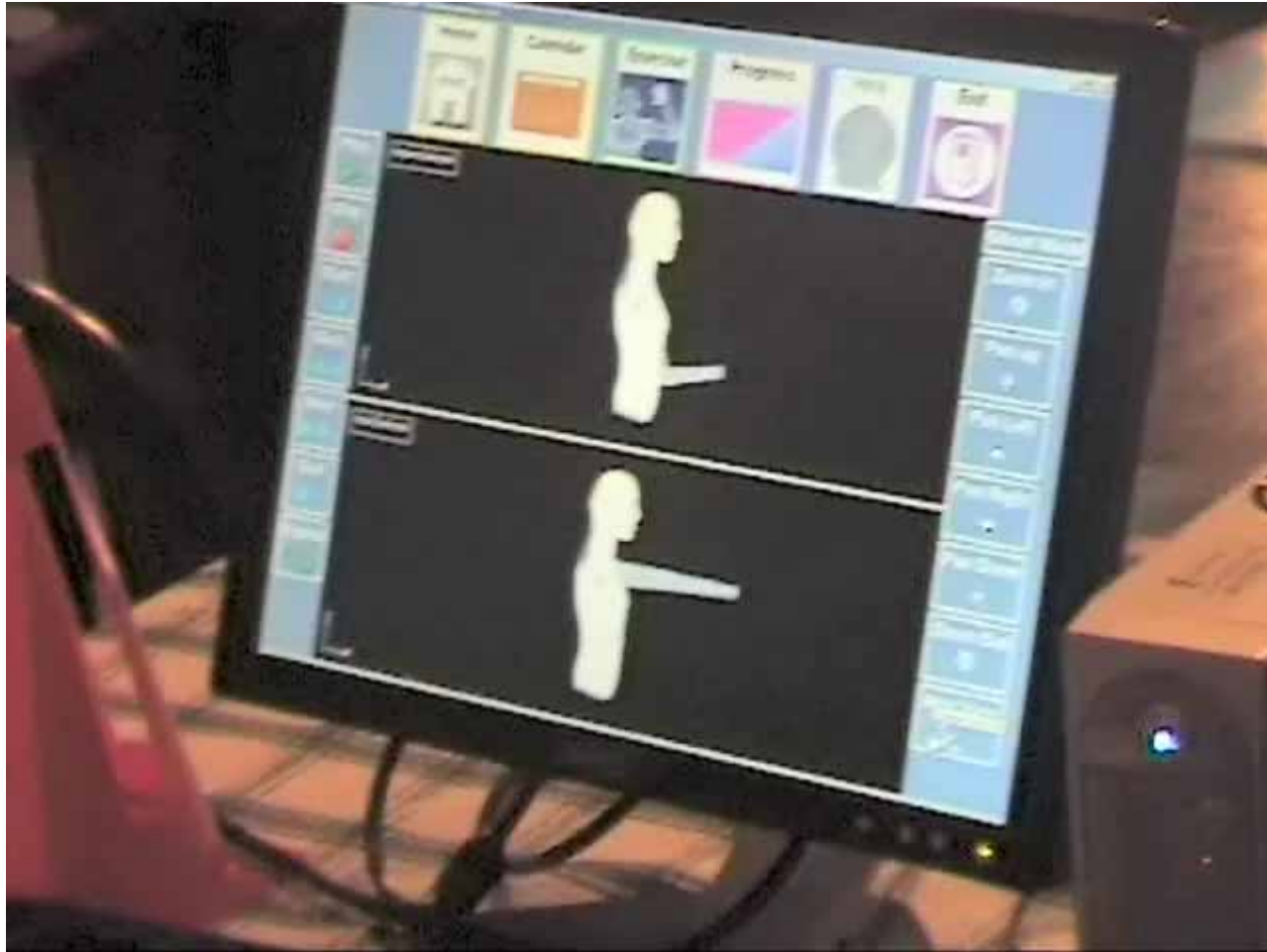
Case studies

- 4 stroke patients post discharge from rehabilitation
 - Time since stroke: 7 months to 4 years
 - Mean age: 61.5 (SD 27.5)
 - Gender: 2 male 2 female
- Protocol
 - Following demonstration patients were instructed to self manage the frequency of upper limb exercise.
 - Pre intervention measures were collected
 - Post intervention measures collected by independent assessor

Home Test of SMART system: moving



Home Test of SMART system: analysing



Quantitative outcome measures

- Timed get-up and go
- Motor Assessment Scale
- TELER x 3 (Individual functional goal)

Type of change	Number of items	Percentage
Deterioration	2	10%
No Change	8	40%
Improvement	10	50%
Total	20	

Qualitative methods and outcomes

- Semi-structured interviews
- User diary – on screen and paper option
- Video of user carrying out rehabilitation tasks

Users wanted: Comparison with target, real time display, chart showing progress over time, wireless sensors.

Quotes from case studies

"There's someone watching me"

"What I liked about it was that he was so eager to do it. He'd ask me 'shall I do it again? Shall I do it again? ...It's really amazing that he was really wanted to do these exercises much more..."

" Having viewed it visually I'm aware that this elbow swings out...people can see the difference between what they can do and what they should be doing"

Fusion of SMART with Stroke Exerciser

- Approached by Philips in 2006 to work in collaboration
 - wireless sensors
 - smaller sensors
 - different patient interface with avatar
 - voice
 - different feedback display
 - laptop
 - currently working on further developments of the newly named TARGET system.

PHILIPS

TARGET system in use



Website:

<http://research.shu.ac.uk/chscr/smart>

www.fp.rdg.ac.uk/equal/

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