Motivating Mobility

Interactive Systems to promote Physical Activity and Leisure for people with limited mobility …

A Collaborative EPSRC project
Aim: Motivating people with mobility issues to engage in physical, cognitive and leisure activity and connect people through interactive and mobile technology using fun, games and real-world leisure activities
The problem

- An aging population living longer and needing to stay active
- The percentage of people in England who are over 65 will increase from 16% in 2003 to 23% in 2030
- 150,000 new strokes a year in the UK consuming more than 4% of the NHS budget
- The cost of stroke care in Europe is predicted to rise in real terms by 30% between 1991 and 2010
- The promotion of health and an active life central to National Service Framework
The Team

**People Centred Design**
Geraldine, Lesley *(Sussex)*. Technology across generations

Ian, Thomas *(Dundee)*: requirements capture

**Developers**
Tom, Stef *(Notts)*
Location based software,

Ian, Thomas *(Dundee)*
Useable/accessible HCI

Penny, Nour *(Oxford)*
Measurement, motion modelling,

**Clinical Practitioners**
Sue *(Sheff)* Upper limb spasticity, rehab tech

Jane, Ruth *(Soton)*
Motor learning and control.

Zoe *(DRI)*
Telecare, assistive tech

**Partners**
NHS and private clinics: stroke patients
Stroke Assoc and stroke patients
Age Concern
ACPIN
Key Challenges for Rehabilitation

Evidence base
• Repetitive exercises do improve mobility

Challenges
• Motivating
• Personalised - meet the needs of individual – relevant and practical
• Effective – it must also encourage recovery of good quality movement
• Understanding what works and why

Can we create a technology that would:
• Fit into real homes
• Fit into real lives
• Be fun and motivating so people want to use it
• And.............that would promote mobility after stroke?

JHB
Objectives

- Identify practical technological arrangements for real world users that meet real needs
- Designed in partnership with users
- Develop engaging and stimulating content to motivate people with loss of upper limb function following stroke
- Assess the clinical benefits and accessibility of the approach in real world settings
- Develop a strategy for scale up.
Overall Approach

• **Integration of clinical, technical, user concerns**
  – Clinical requirements – physio videos
  – Technology analysis
  – User research
    • into patient experience, formal/informal carer needs, physical space constraints, etc

• **User centred design and evaluation**
  – User engagement at every stage
  – Design led iterative prototyping
  – In-situ user trials

• **User/stakeholder workshops**

• **Clinical Case Studies/Assessment**
Understanding the patient / stroke experience

• Working with patients, families, physiotherapists, carers
  – Online stroke stories
  – Stroke club workshops
  – Home visits, interviews

• Range of exploratory ‘probes’ into patient experience
  – Informed by motivation theories
Examples of data being collected

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Overall comments on experience

• Diversity of ages, disabilities, family situations, life experiences… unsurprisingly!

• But many shared experiences
  – Frustrations
  – Fatigue
  – Depression
  – Determination
  – Social isolation
  – Therapist support
Real people in real homes

Sam’s house –
use of rooms has changed
(was ‘Ideal Home’ 1948)

Roland’s house:
it has all got too much -
problems with cleaning,
organizing, DIY and
forgetfulness
Things that are precious

Irene: a lifetime of work, duty and achievement

Albert: glassware that tells stories and the family tree

Vanessa: charitable giving and a toy for every occasion
The place of technology

Among the flowers

Put safely away

Obscured by the table

In the rarely used front room

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In the ramshackle ‘studio’
Emerging ‘content’ themes

Reminiscence: things that mean something, but put aside, stored ........or given away.

- Music

Hobbies and things that it is no longer possible to

- Types of games, challenges

- Keeping in touch with family and friends far away

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Bringing user & clinical data together via personas

<table>
<thead>
<tr>
<th>Level of ability</th>
<th>Elbow/shoulder</th>
<th>Grasp and release</th>
<th>Elbow/shoulder combined with grasp and release</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>2 DOF: Slow (own time) Close to the body or directly in front of the body</td>
<td>Grasp and release (large, soft, non-slippery objects placed close to the body)</td>
<td>Grasping objects, moving them through small distances close to and in front of the body in 2 DOF releasing them</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>3 DOF: Faster encouraged to increase speed Further from the body and out to the body</td>
<td>Grasping and releasing objects placed close to the body</td>
<td>Using small objects, performing highly skilled complex tasks that involve 3 DOF</td>
</tr>
<tr>
<td>HIGH</td>
<td>3 DOF: greater distances away from the body Activities in standing Speed/competition</td>
<td>Using small objects, performing highly skilled complex tasks that involve 3 DOF Speed/competition</td>
<td>Using small objects, performing highly skilled complex tasks that involve 3 DOF Speed/competition done in standing</td>
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Clinical functional matrix

User case studies

Personas to convey diversity of patient experience & clinical drivers

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Moving to design ideas

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Personas

Tech explorations

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Storyboards
Example storyboard - chess

Play chess with other users

Control the game with a special exercise mat. Select a piece by moving your arm up and down on the exercise patterns.

When you have the piece you one to move highlighted press the red select button.

Now your opponent (who could be another stroke patient, friends or family) has his go.

Select a destination for the piece in the same way.
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<th>Example storyboard – astronomy hobby</th>
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1. Mike is given an application that allows him to explore planets in the solar system. To interact with this application he uses an active surface and a set of blocks. The active surface is labelled with a set of active areas. Mike interacts with these areas by placing blocks on them.

2. Blocks are provided in a range of sizes and materials, and this enables Mike to practice different “grasp and release” movements.

3. Placing a block on one of the areas in the pink section rotates the globe in one of four directions.

4. Placing a block on one of the areas in the green section zooms into or out of the globe.
Technology challenges

How to make the applications:

• **Adaptive** to individual needs?
  – Content that can be swapped in/out?
  – Grading of tasks – in response to performance?

• **Feedback** in different forms
  – To patients
  – To carers/physios?

• **Fit** into ‘everyday’ homes?
  – Re-use existing objects in the home?
  – Be used in different places, sitting and/or standing?

• **Easy** to set up and use?
  – By both physio to design exercises and patient/carers to use?
Next steps

- Involving physiotherapists as users of the system
- Video and audio analysis and grounded theory to identify motivational and other themes
- Designing a range of possible technologies that are non-threatening, motivating, fun and will fit into real homes and real lives
- Developing video prototypes of possible technologies to show users
- Workshops for people living and working with stroke to give us feedback – leading to selection of design to develop
- Accurate measurement of movement and evaluation of the technology’s effectiveness for training specific upper limb movements
Impact

• More active lifestyle leading to Better health

• Increased independence throughout life

• Improved social interaction and connection to local community and family

• Functional and impairment improvements

• Illustration of innovative therapies and strategy to scale these up