Motivating Mobility

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

A Collaborative EPSRC project

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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

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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

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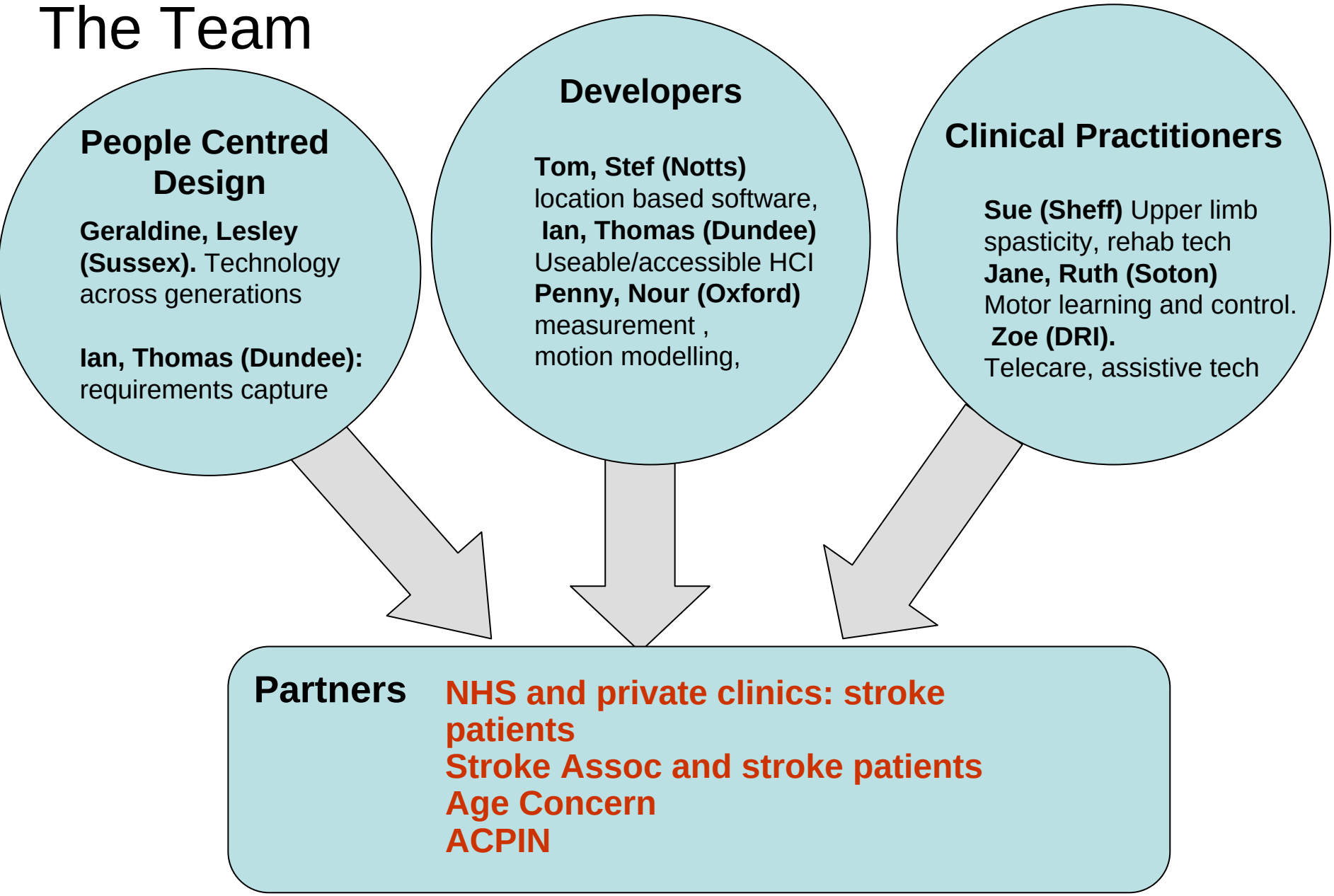
The Team


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

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Key Challenges for Rehabilitation

Evidence base

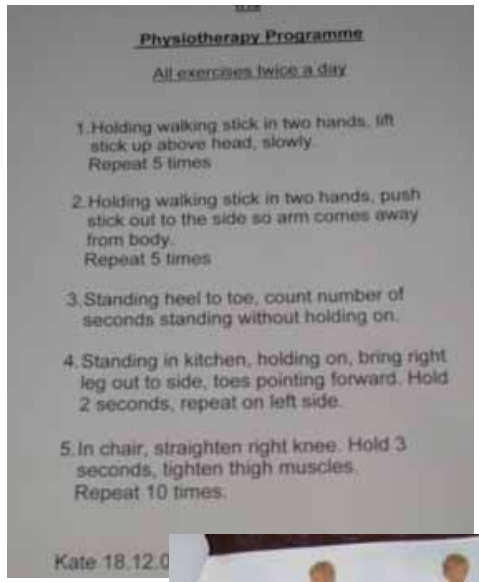
- Repetitive exercises do improve mobility

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?



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.

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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

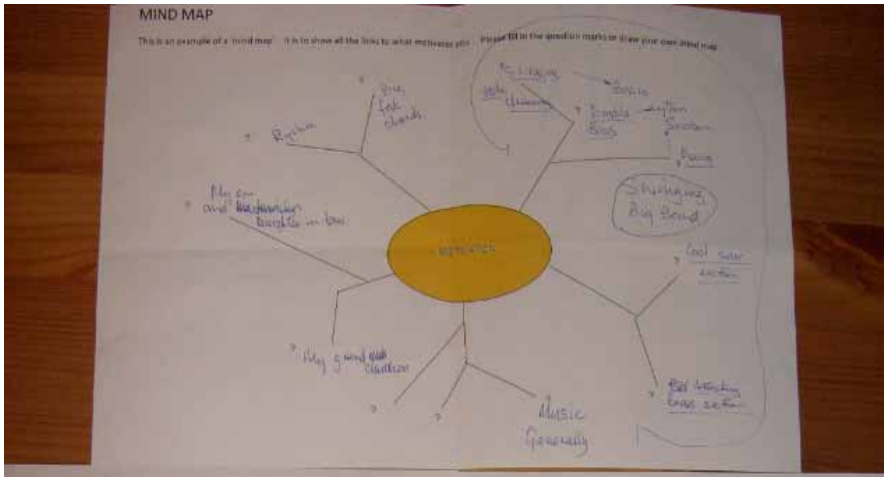
- User/stakeholder workshops

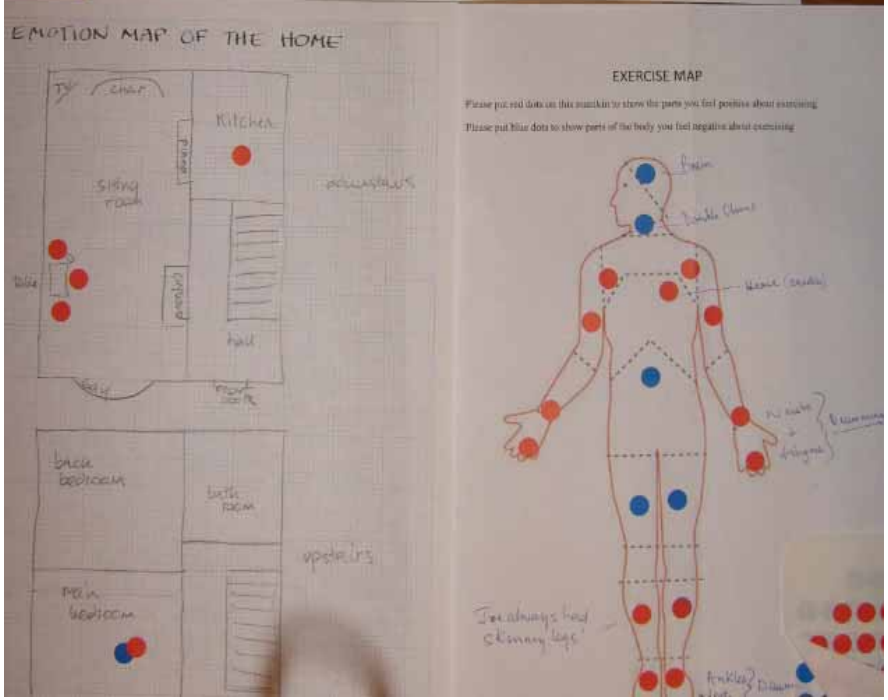
- Clinical Case Studies/Assessment

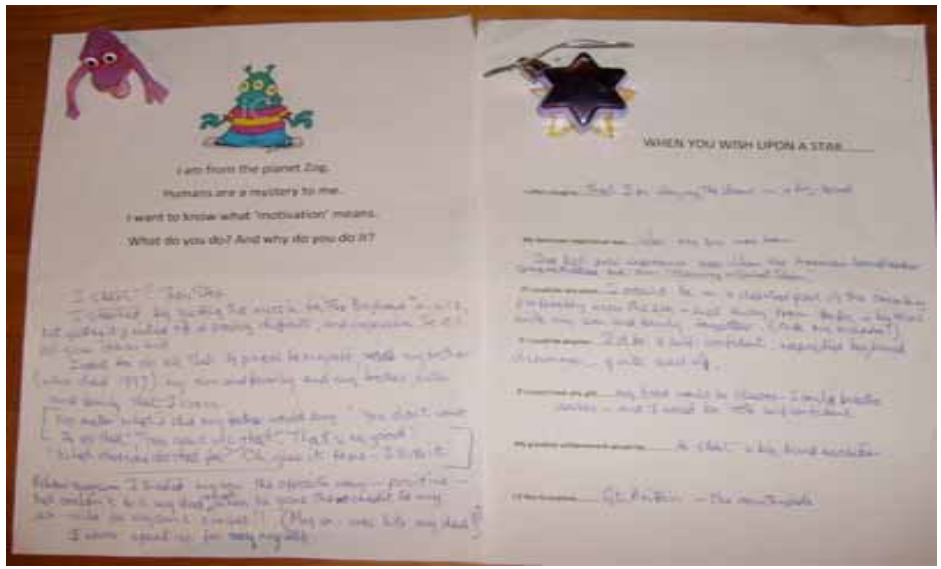
Understanding the patient / stroke experience

- 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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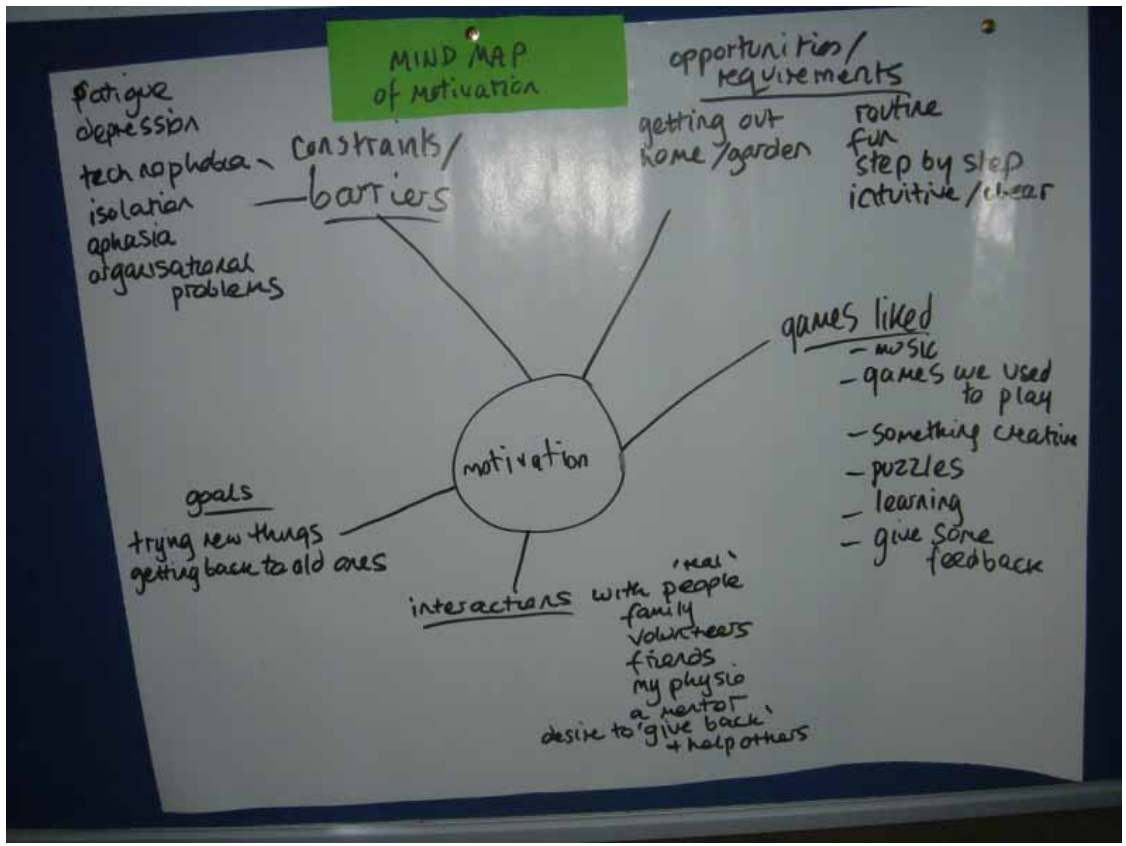
Overall comments on experience

- 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)

Kitchen ⇨
bathroom

sitting room ⇨
bedroom/toilet

Roland's house:

it has all got too much – problems with cleaning, organizing, DIY and forgetfulness

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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

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The place of technology

Among the flowers

Put safely away

In the rarely used front room

Obscured by the table

In the ramshackle ‘studio’

Emerging ‘content’ themes

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

Hobbies and things that it is no longer possible to

Music

Types of games, challenges

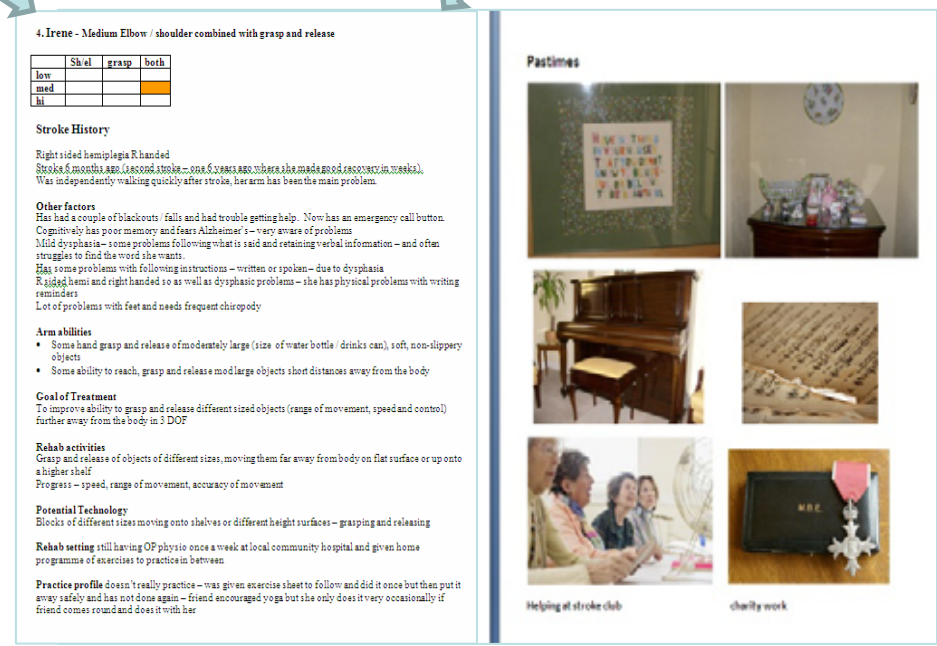
Keeping in touch with family and friends far away

Bringing user & clinical data together via personas

	Class of activity		
Level of ability	**Elbow/ shoulder**	**Grasp and release**	**Elbow / shoulder combined with grasp and release**
LOW	2 DOF Slow (own time) Close to the body or directly in front of the body		
MEDIUM	3 DOF Faster encouraged to increase speed Further from the body and out to the	Grasp and release mod large, soft, non-slippery objects placed close to the body	Grasping objects, moving them through small distances close to and in front of the body in 2DOF releasing them
HIGH	3 DOF greater distances away from the body Activities in standing Speed / competition	Grasping smaller objects that require manipulation Including pronation / supination Speed / competition	Using small objects performing highly skilled complex tasks that involve 3 DOF Speed / competition done in standing

Clinical functional matrix

User case studies



4. Irene - Medium Elbow / shoulder combined with grasp and release

	Sh/el	grasp	both
low			
med			
hi			

Stroke History

Right sided hemiplegia R handed
Stroke 6 months ago (second stroke – one 6 years ago where she made good recovery in weeks).
Was independently walking quickly after stroke, her arm has been the main problem.

Other factors
Has had a couple of blackouts / falls and had trouble getting help. Now has an emergency call button.
Cognitively has poor memory and fears Alzheimer's – very aware of problems
Mild dysphasia – some problems following what is said and retaining verbal information – and often struggles to find the word she wants.
Has some problems with following instructions – written or spoken – due to dysphasia
R sided hemi and right handed so as well as dysphasic problems – she has physical problems with writing reminders
Lot of problems with feet and needs frequent chiropody

Arm abilities
- Some hand grasp and release of moderately large (size of water bottle / drinks can), soft, non-slippery objects
- Some ability to reach, grasp and release mod large objects short distances away from the body

Goal of Treatment
To improve ability to grasp and release different sized objects (range of movement, speed and control) further away from the body in 3 DOF

Rehab activities
Grasp and release of objects of different sizes, moving them far away from body on flat surface or up onto a higher shelf
Progress – speed, range of movement, accuracy of movement

Potential Technology
Blocks of different sizes moving onto shelves or different height surfaces – grasping and releasing

Rehab setting still having OP physio once a week at local community hospital and given home programme of exercises to practice in between

Practice profile doesn't really practice – was given exercise sheet to follow and did it once but then put it away safely and has not done again – friend encouraged yoga but she only does it very occasionally if friend comes round and does it with her

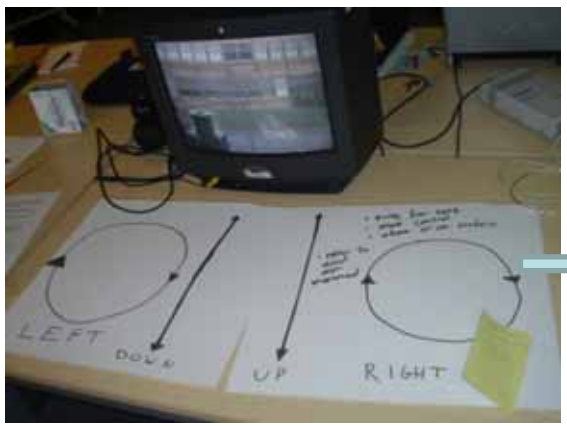
Personas to convey diversity of patient experience & clinical drivers

Moving to design ideas

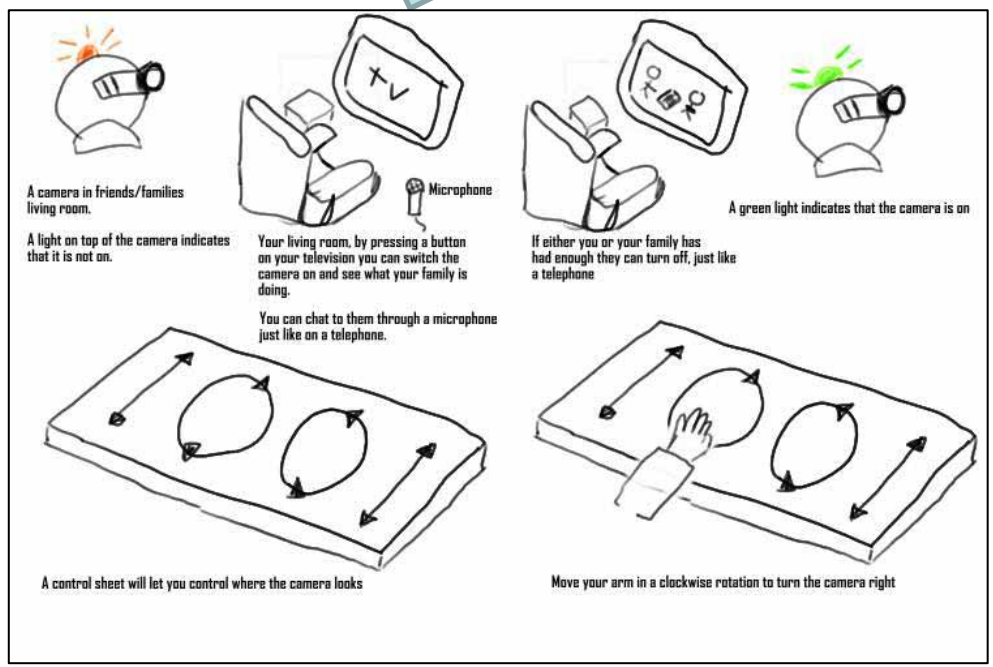
Personas

Level of ability	Elbow/shoulder	Grasp & release	Combined
LOW			
MEDIUM			
HIGH			

Clinical functional matrix



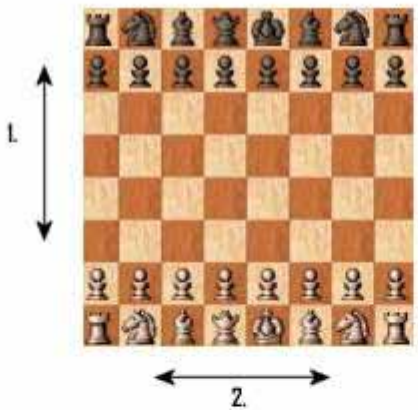
Tech explorations



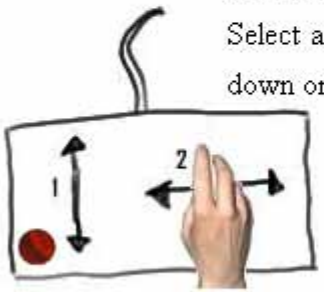
Storyboards

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.

Select a destination for the piece in the same way

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

Example storyboard – astronomy hobby

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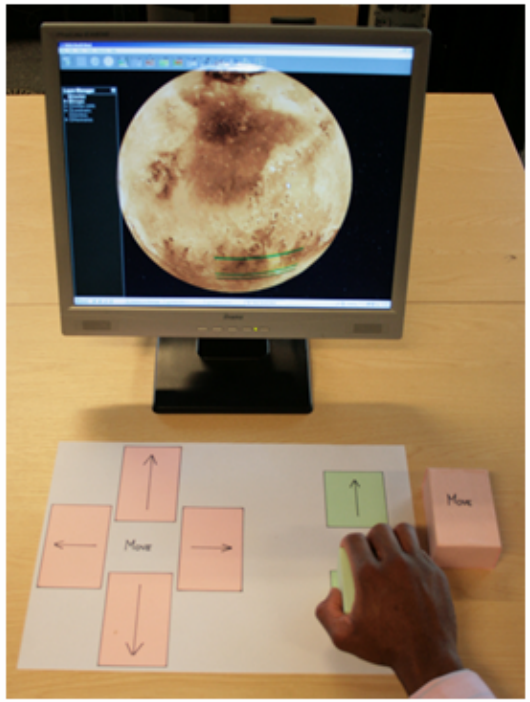
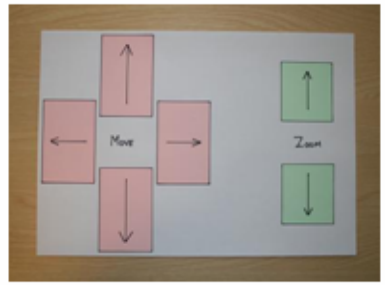


Mike is given an application that allows him to explore planets in the solar system. To interact with this application he uses an *active surface* and a set of blocks.

2.

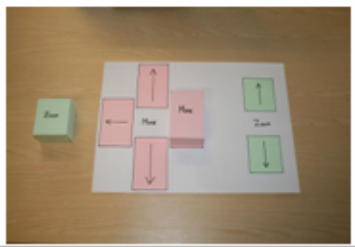


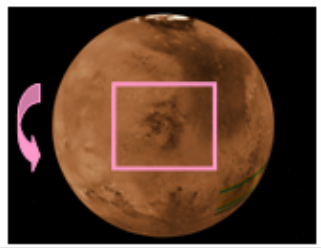
The active surface is labelled with a set of *active areas*. Mike interacts with these areas by placing blocks on them.

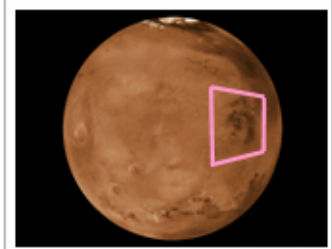
3.

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

4.

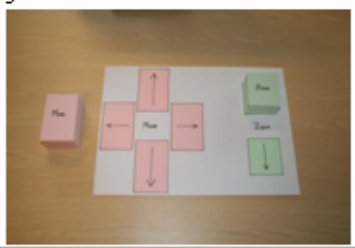


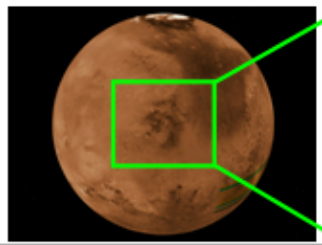


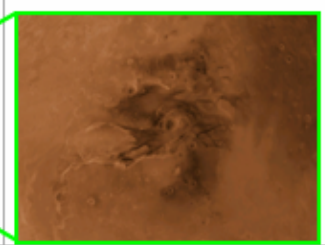


Placing a block on one of the areas in the pink section rotates the globe in one of four directions.

5







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

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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

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