The Jerusalem TeleRehabilitation System

 Effective treatment

- Exercise-based,
- Delivered at an appropriate intensity
- Involve repetition.
- Repetitive movement is more effective for recovery when it is challenging and meaningful
  - (Krebs, Hogan et al 2004)
  - (Coote and Stokes, 2005)

Heidi Sugarman
Ehud Dayan
Aviva Weisel-Eichler
Joseph Tiran
hsugarman@ono.ac.il

Cybertherapy 2006
However

• Amount of time patients spend in therapy is limited as compared with normal activity and therefore might not optimize the cortical reorganization necessary for recovery.

Unfortunately

• Not all patients receive the therapy that they need for as long as they need it
• 2 reasons:
  – Economic pressures
  – Distance from rehabilitation centres
Technology to the Rescue!

**Robot mediated therapy**
Automated and precisely controlled  
Diverse sources of feedback  
Adjustable to the specific needs of individual patients  
Surrogate therapist – increase the amount of therapy

**Telerehabilitation**
The delivery of medical rehabilitation services at a distance via the internet,  
Has the potential to increase the amount of therapy by providing high-quality rehabilitation services, at low cost, in the patient’s home

A marriage made in heaven

- Make robots available for home use  
- Merge rehabilitation robotics with telerehabilitation
Some robots used today

- Rutger’s ankle
- Rutger’s hand
- MIT Manus
- Motorika

A low cost haptic robot

- Force feedback joystick (Reinkensmeyer)
- 2 motors at right angles to each other
- Several FFJ’s on the market
- Microsoft Sidewinder had the highest sampling rate, the smoothest movement and the best accuracy of forces
The Jerusalem Telerehabilitation System

Consists of:
- Force feedback joysticks
- Ordinary PC’s
- Standard broadband internet connection
- A specially designed arm rest

The arm rest

- Attaches to the patient chair
- Allows control of the joystick via movements of the shoulder and elbow joints
- Doubling the height of the handle doubles the ROM of the joystick
2 modes of operation

- Cooperative mode
  - Patient and therapist work together
- Stand-alone mode
  - Patient works alone

Cooperative mode

Therapist & patient are online at the same time
Motivating factor
What does it look like?

- Patient and therapist each see, in real time, the position and movement of their own joystick plus the position and movement of the other party’s joystick.
- The patient and therapist’s systems are totally synchronized.
- Therapist can demonstrate mvmnts or guide the patient’s joystick (her joystick acts as a magnet).

How large is the lag between joysticks?

- Vertical Movement: 30-150 msecs
- Oblique Movement: 30-150 msecs
Stand alone mode

- Patient logs onto machine, performs his designated therapeutic exercises which have downloaded onto his machine
- Does not have to be online while exercising
- Results of exercise session + program updates will be transferred automatically via the Internet
Stand alone mode

- Joystick can assist or resists movement
- Joystick is moved by the creation of “force corridors”
- Target acts as a magnet

Record of patient movements

- A text file recording the exercise session is stored locally and uploaded to the server at a later time.
- A graphical representation of the client’s movements is available via the “graph animator”
Useability of the system

- Systems that are difficult to use or that require prolonged training time will not be accepted by therapists or patients
- Tested the stand-alone system with 2 therapists and 2 people with stroke
Therapists

- Overcame initial technophobia
- Learned to use the system in 1 training session
- No problem remembering and using various features
- Looking forward to using the system on more patients

Stroke subject 1

- 65 year old woman 2 months post stroke
- Apathetic
- No experience at all with computers
- Brightened up when she started to play
- Able to make the transformation from cursor movement to joystick movement
Stroke subject 2

- 65 years old
- 10 years post stroke
- Electrical engineer
- Advisor to the project
- Tried out the arm rest

Conclusions?
Thank you

- Ehud Dayan
- Aviva Weisel-Eichler
- Joseph Tiran
- Arnon Lauden
- Eyal Ben Moshe