The Jerusalem TeleRehabilitation System

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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)

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

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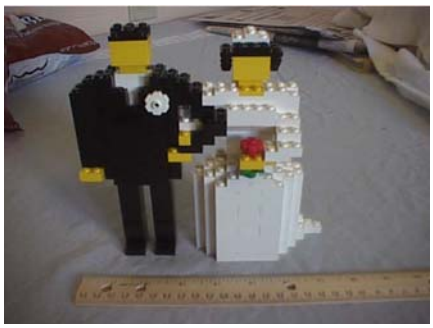
A marriage made in heaven

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



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Some robots used today

Rutger's ankle

Rutger's hand

MIT Manus

Motorika

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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

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The Jerusalem Telerehabilitation System

Consists of:

- Force feedback joysticks
- Ordinary PC's
- Standard broadband internet connection
- A specially designed arm rest

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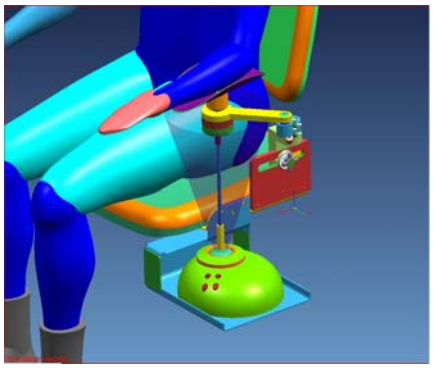
The arm rest

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



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2 modes of operation

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

Cooperative mode

Therapist

Internet

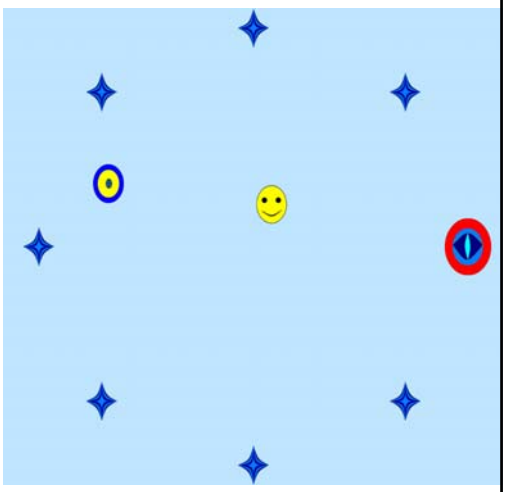
Patient

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)



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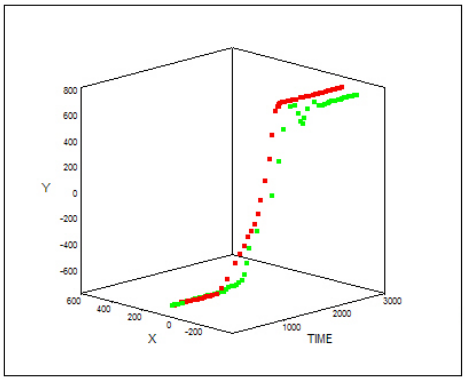
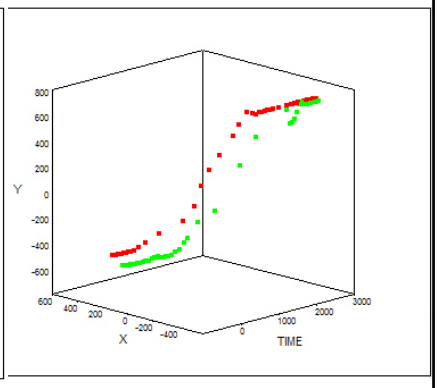
How large is the lag between joysticks?

therapist

patient

30-150 msecs





Vertical Movement

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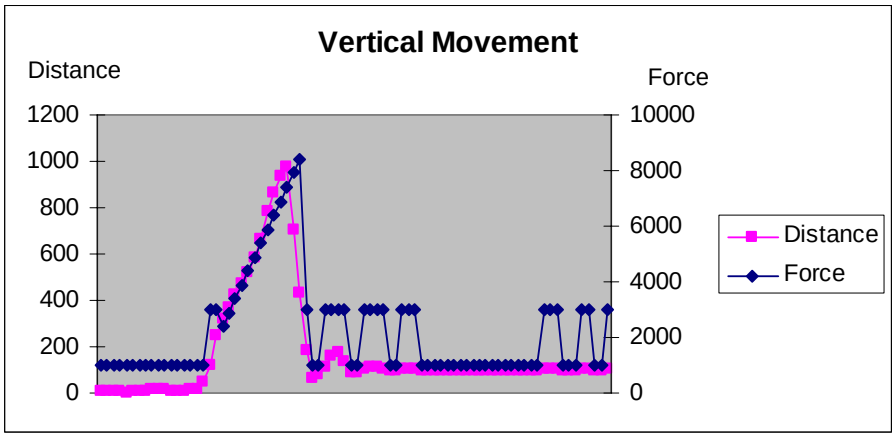
Oblique Movement

Distance and Force

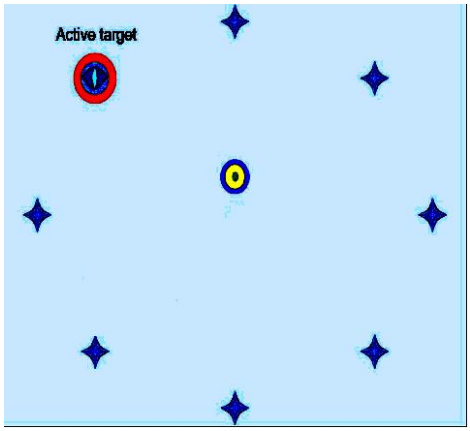


Stand alone mode

- 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



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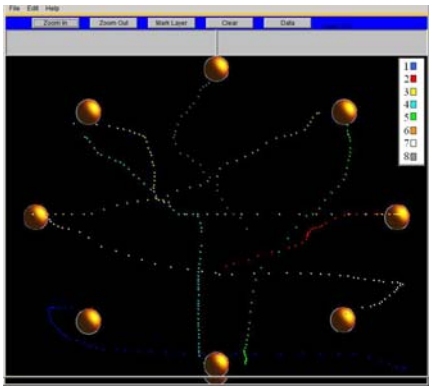
Record of patient movements

- 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”



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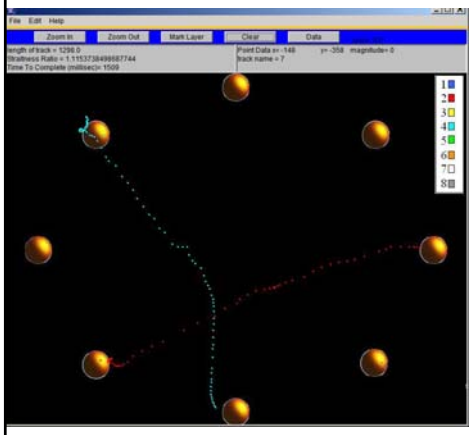
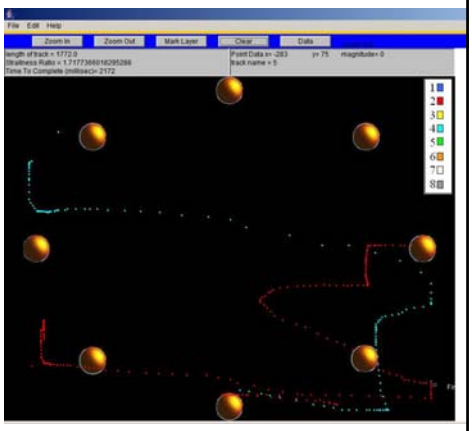


normal



stroke

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

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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

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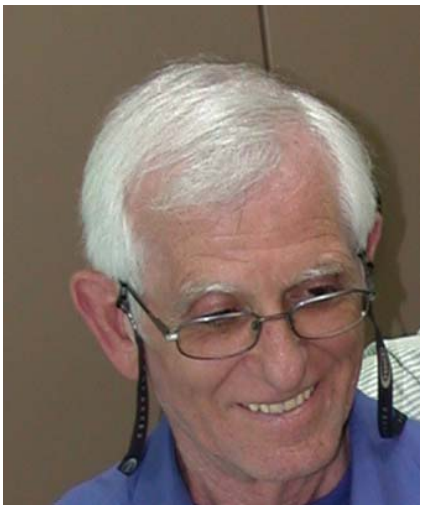
Conclusions?



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Thank you

- Ehud Dayan
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- Joseph Tiran
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- Eyal Ben Moshe