In Touch with Computing

GIST
Glasgow Interactive Systems Group

UNIVERSITY of GLASGOW

http://www.dcs.gla.ac.uk/~mcgeemr

Mail: mcgeemr@dcs.gla.ac.uk

Overview

- What is Haptics?
- Haptic technology
- Haptics research at Glasgow

What is haptics?

- *Haptic* (hap'tik) :
  - adj.[Gr. haptein, to touch + ic]
  - of, or having to do with, the sense of touch; tactile.
  - *Webster's New World Dictionary*
- Computer haptics is complex and difficult to describe – it is better experienced.

The Sense of Touch (Haptics)

- Relatively unused in computing
  - Implicit – keyboards keys, casing of mouse….
  - Explicit – programmable touch
- Beginning to change - devices are emerging
  - History – teleoperation devices
  - New devices – cheaper, smaller, better…
- Touch is a complex modality
  - Better understanding required through research
  - Confusing terminology clouds matters.

Terminology

- Haptic
  - Relating to the sense of touch.
- Kinesthetic
  - Meaning the feeling of motion. Relating to sensations originating in muscles, tendons and joints.
- Cutaneous
  - Pertaining to the skin senses - sensation of temperature, pain, and movement (e.g. pressure, stretch, and vibration).

Tactile Technologies

- Tactile information is produced by perturbing the skin
  - Pins or other mechanical vibrating elements
  - either alone or in an array, as in devices for Braille display
  - Air jets - blow to produce a disturbance
  - Inflatable cushions of air – provide varied pressure on skin
  - Electrical stimulation - low levels of current provide a localised tingling sensation
- Typically used in gloves
- These technologies lack realism

Force-Feedback Technologies

- Kinesthetic information is produced by exerting mechanical forces
- Technologies are easier to produce than tactile
  - now reaching users at home
    - Consoles - Dual Shock, Rumble Pack cost £15
  - PCs - 2 dof force-feedback joysticks cost £50
    - Reasonable fidelity
  - Force-feedback mice - 2 dof mice
    - Similar technology to the joysticks. Mainly geared towards a gaming market but also include a "haptic desktop".



Force-Feedback Technologies

- Several high end devices exist
- The PHANToM is a typical example
  - Provides 6 dof in, 3 dof out
  - Produces rich feedback suitable for many applications
  - Costs £20000+
- Point contact model of touch
- Algorithms for force feedback - the KX model to produce barriers
  - force exerted = K * X
  - Where X is the distance beyond the barrier, K a stiffness constant

Potential uses for haptics (1)

- To increase the realism of an object
  - Games
- To increase presence or immersion
  - VR
- To give an object subjective/aesthetic properties
  - E-commerce
- To constrain the user to an object
  - Haptic desktop – scroll bar
- To guide the user over/through/to an object
  - Guided exploration

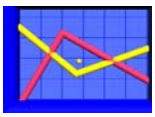
Potential uses for haptics (2)

- To add social context
  - CSCW, sex industry?
- To train a user in a haptic related task
  - Critical procedure training
- To overcome limitations in other modalities
  - Interfaces for the visually impaired
- To produce richer interaction or visualization
  - Haptic visualization
- To convey information about an object
  - What it is, where it is, how rough it is…..

Haptics Research at Glasgow University

MultiVis

- Haptic presentation of information to visually disabled
  - haptic graphs
  - multimodal tables



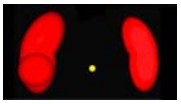
- Multimodal approach provides best results
  - Haptics good for guidance
  - Non-speech audio good for discerning trends
  - Speech cues good for exact values

Desktop Haptics

- Desktop is designed to be easy to use but……. Visual overload
- Haptically enhanced widgets can aid targeting
  - texture, friction, recess, gravity
- Evaluation
  - buttons individually
  - combined in a scrollbar
  - in a menu system
- Found performance improvements
  - significant decreases in errors, but not in time taken.
  - gravity or recess tend to be best.
- Appropriate design can prevent obstructive forces, while maintaining supportive ones.

Vets

- Training vet students presents intrinsic problems
  - Risk posed by novices to animals
  - Maintenance of animals
  - Large ratio of students to patients
  - Non-exposure to rare conditions



- Haptics could solve these problems - virtual training
- Horse Ovary Palpation Simulator (HOPS)
  - allows students to practice a general purpose, potentially hazardous operation
  - tests indicate HOPS is as effective as traditional training

CSCW

- CSCW - Computer Supported Co-operative Work
  - increased presence and interaction (fun)
  - spatial communication
- Collaborative editors
  - allow distributed users to work on same document
- Problems with awareness & information deprivation
  - Add and evaluate haptics in a shared editor
    - Pushing, Pulling (gesturing), Locating, Proximity

Multimodal Interfaces

- Multimodal - presentation of information directed at different senses.
  - TV is multimodal - it has both pictures and sound
  - Can provide complementary, supporting information
- Information from different modalities interacts in a complex way.
- Investigating the further potential of this effect
  - Could increase bandwidth of sensory channel
  - Discover guidelines for multimodal combinations

Multimodal Roughness of Textures

- For feedback devices are intrinsically kinesthetic
  - Yet some textural properties might be better conveyed to the cutaneous sense
- Force feedback based textures
  - Require large workspaces
  - Can throw users from textures area
- Improve quality and/or quality of force feedback generated textures through the addition of another modality (auditory cues).

Conclusions

- Haptics can provide benefits to a diverse set of domains
  - Physical training, Collaboration, Visualisation, Targeting, Ecommerce, CAD,……
- Haptic devices are beginning to become commonplace
  - Yet relatively little is known about how best to use them
- Research is required now

In Touch with Computing

UNIVERSITY
of
GLASGOW

- www.dcs.gla.ac.uk/~mcgeemr