‘Head up’ Interaction

Can we break our addiction to the screen and keyboard?

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Multimodal interaction

Multimodal Interaction Group

Key area of work is *Multimodality*

More human way to work

- Not everyone has all senses
- May not always be available all of the time

No one sense can do everything on its own

Application areas

Ubiquitous computing

Non-visual mobile computer interfaces

- *Used on the move*
- *Mobile evaluation*

Accessibility

- Blind users and visualisation
- Older adults, navigation, mobility
- Home care

Camera user interfaces

Technologies

- Non-speech audio
  - Earcons
  - 3D sound
- Computer haptics
  - Force-feedback, pressure input, temperature output
  - Tactile (vibrotactile and pin arrays)
- Gestural interaction
  - On-screen, multi-touch
  - Accelerometers, gyros, magnetometers, GPS
- Smell

Overview of talk

Problems with interaction in a mobile world

- Screens and keyboards limit our interactions
- Not always appropriate
- Not appropriate for everything

‘Head-up’ interaction

- Multimodal solutions
- Gestures for input
- Audio and tactile displays for output
- Example interactions

Interaction problems

Mobile interaction takes place in the real world

- Users involved in other tasks
- On the move
- Contexts very varied
- Users need effective ways to interact with sophisticated new applications and services
- Current devices make interaction difficult

Screen is limited

Screen space small

Eyes heavily used when mobile

- Using up too much visual attention is dangerous

Hard to design good graphical interfaces for mobile use

Input is limited

- Keyboards and pens hard to use when mobile
  - Buttons are small
  - Input difficult and error prone
  - Requires much visual attention
  - Two hands
- Touchscreen phones lose important tactile features
  - Requires more visual attention

‘Head down’ interaction

Hard to use devices when mobile

Disengaged from world

Solutions?

‘Head up’ interaction

- Interactions that allow people to get on with their lives whilst using the technology
- ‘Eyes-free’ and ‘Hands-free’ ?

Need to develop new interaction techniques that suit real environments of use

- Multimodal interaction
- Gestural and pressure for input
- Non-speech and synthesised speech sounds + tactile displays for output

Why gestures for input?

Kinaesthetic perception means gestures are ‘eyes free’

- ‘Head-up’ input

Types

- On screen of the device
- Device in hand
- Different body locations

Self-contained, no screen or surface needed

- Can be one handed, no handed
- Good if users are involved in something else, e.g. carrying, operating machinery

Multi-touch interaction

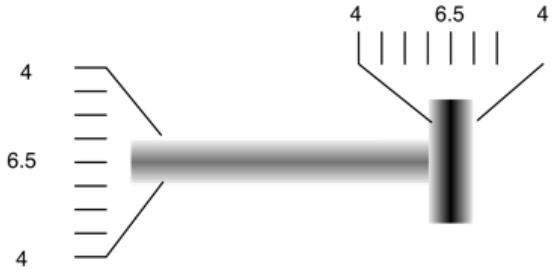
On-screen gestures

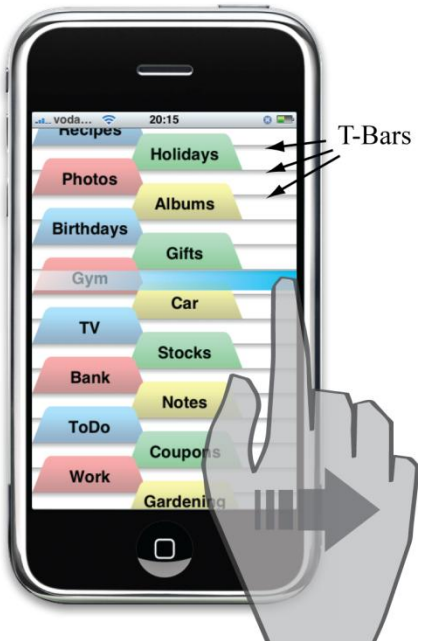
Tactile guidance for gestures

- T-bars
- Dynamic feedback
- Keep finger on target

File-o-feel

Touch-n-twist





Head gesture interaction

- Non-visual interface where users could nod at audio sources to select them
  - Hands-free
  - 3D audio for output
    - Will discuss more of the audio design later
- Gesture recognition based on angle/dwell time of head
- Worked well when users were mobile
  - People could easily nod and walk
  - Backward nods not ideal

Wrist gestures

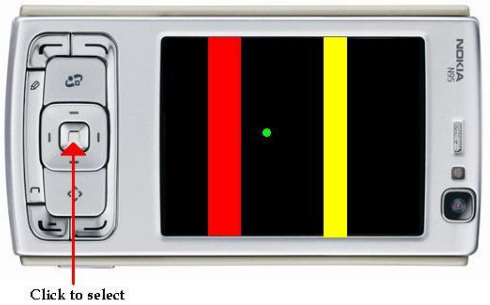
Can rotate wrist to control a cursor

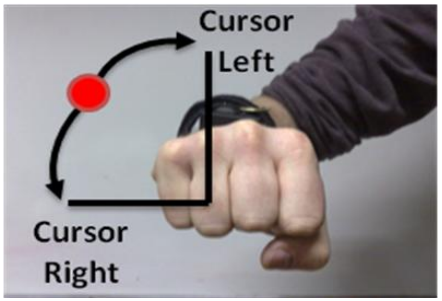
- Discreet form of input whilst holding a bag

Investigated whether users could select targets using wrist

Very effective

- 90% accuracy for 9° targets
- Mobile recognition techniques are challenging





Pressure input

Little studied in HCI, but a rich source of input and control

- Musical instruments, drawing, holding / grasping

Can we uses pressure as another input mechanism?

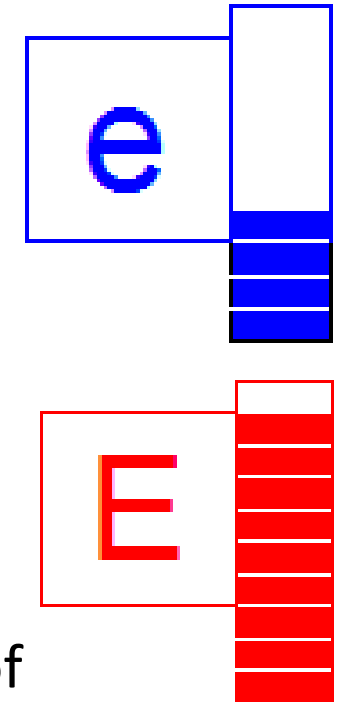
- Discrete and continuous
- Button pressing, zooming, scrolling

Pressure keyboard

- Hard press for uppercase, soft press for lowercase

Pressure input

- Pressure keyboard on Nokia N800
  - Light press = lower case,
    hard press = upper case
- Graphical pressure meter
  - Dynamic feedback
- Compared dwell (0.5 sec), quick release and normal keyboard (shift key)
  - Audio feedback to confirm dwell time and case of letter typed
- Users were sitting and walking



Pressure interaction

Results showed that Quick Release faster than Standard or Dwell keyboard

Dwell had fewer errors than Standard or Quick Release

- Dwell robust to movements of walking as error did not change

Pressure is an effective way to enter mixed case text

Why non-speech sounds for output?

Music, structured sound, sound effects, natural sound

Why non-speech sound?

- Icons vs text, non-speech vs speech
- Good for rapid non-visual feedback
- Trends, highly structured information

Earcons

- Structured non-speech sounds

Combines well with speech

Head up output

Usability improvements

Simple sounds for targeting can increase usability in stylus/button interface by 25% when mobile

- Reduce size of on-screen targets

Used for many other interaction improvements

- Scrollbars, menus, progress bars, …

3D audio interaction

Need to increase the audio display space

- Deliver more information
- Quickly use up display space

3D audio

- Provides larger display area
- Monitor more sound sources
- Non-individualised HRTFs, headphones
- Planar sound (2.5D)

‘Audio windows’

- Each application gets its own part of the audio space

Interaction techniques

Can do 3D audio on mobile phones

How do we use spatial audio?

- Progress indicator
- Diary
- Menus

Combines well with gesture

- Both spatial
- Pointing towards a sound is natural

3D audio pie menus

Users can select audio menu items with head gestures when on the move

- Can walk and select at the same time

Display design is important

Feedback is key

Tactons, tactile icons

Tactile stimulates skin not muscles

Has benefits over visual display

- Eyes-free

Has benefits over audio display

- Personal not public

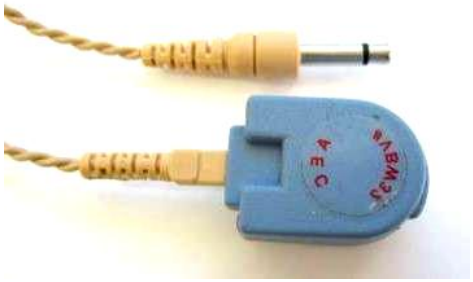
Tactons are structured, abstract messages that can be used to communicate non-visually

Encode information using

- Waveform, duration/rhythm, body location

Tactile technologies

Phone vibration motor



Tactaid VBW32 actuator

C2 Tactor actuator

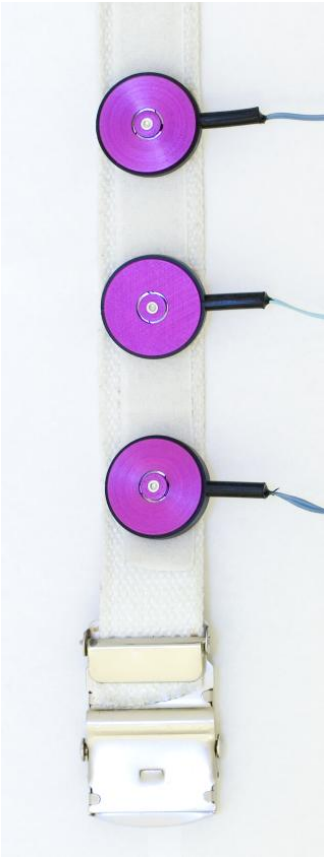
Actuators now in other kinds of devices

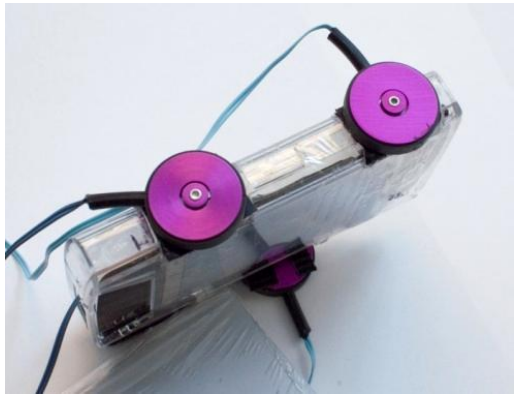
3 cell pin array

Tacton parameters

Spatial location (on forearm, waist, hand) very effective

- Good performance with up to 4 locations
- Wrist and ankle less effective, especially mobile





Tactile interactions

How do we use the tactile display?

Tactile progress indicators

- Time between two pulses
  - Users can monitor for download completion better with tactile display than visual
- Rotation around actuators on hand
  - Again better than graphical display

‘Tactile widgets’

- Buttons, menus, …

Tactile button feedback

Touchscreen phones have no tactile feedback for buttons

- More errors typing text and numbers

Compared performance of real buttons to touchscreen, to touchscreen+tactile

- In lab and on Glasgow subway

Touchscreen+tactile as good as real buttons

- Touchscreen alone was poor

Cameras and camera phones

Interaction is very similar to standard digital cameras

- In turn, similar to old 35mm film cameras

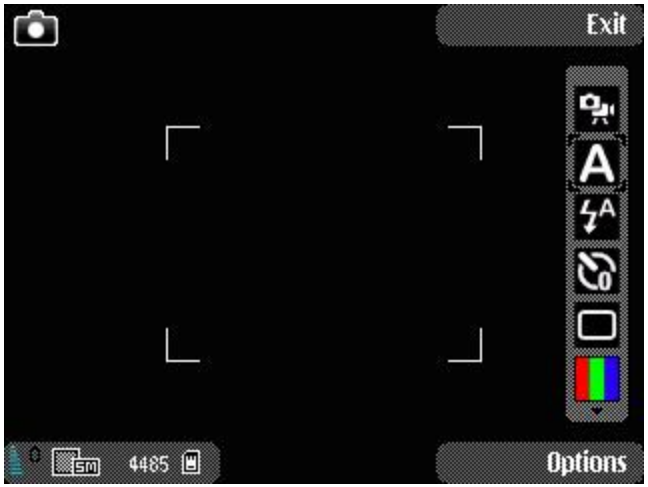
Users have problems taking pictures

- Flash in wrong mode, blurry due to slow shutter speed, memory card full, bad exposure, ...

Could we improve the picture taking process?

- Phones allow new forms of interaction: gesture, multitouch, audio, tactile, ...

Camera displays



Nokia N95 camera phone

Sony DSC-V3 camera including luminance histogram (from www.dpreview.com)

Interaction problems

Users look through LCD to frame the image

Visual attention is on the scene, not the edges of the LCD

- Can miss icons around the edge of screen
- Icons can obscure the scene, so may be turned off
  - Luminance histogram can take a lot of space

Problems taking photos

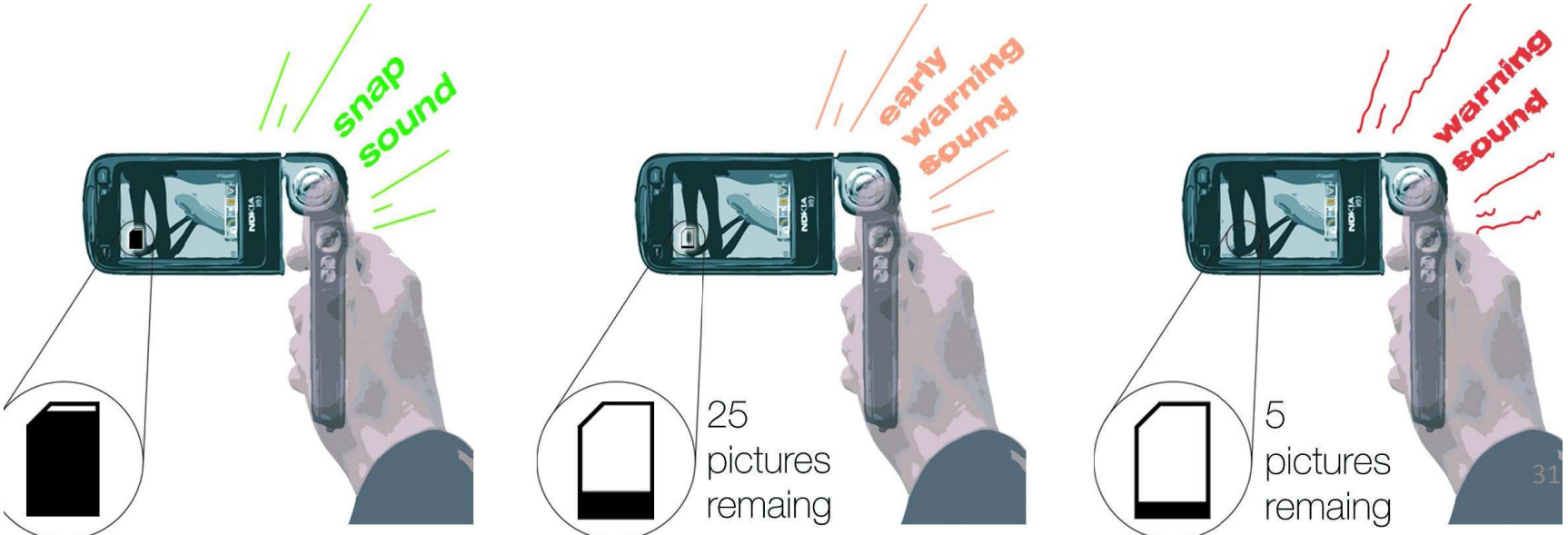
Memory space remaining

Can miss photos when memory card is full

- Visual feedback, sometimes a beep

Replace shutter snap sound

- Gives sonification of memory space remaining when picture is taken



Exposure sonification

- Reduce number of badly exposed photos
- Mapped the y-axis value of the luminance histogram to musical pitch
  - Two notes played: number of pixels with 0 brightness (black), number with 255 (white)
  - High pitch = lots of pixels, low pitch = few pixels
- Hear the histogram on shutter half press
  - Replace focus lock sound
  - ‘Probe’ the scene before taking picture
  - Can correct the image if badly exposed

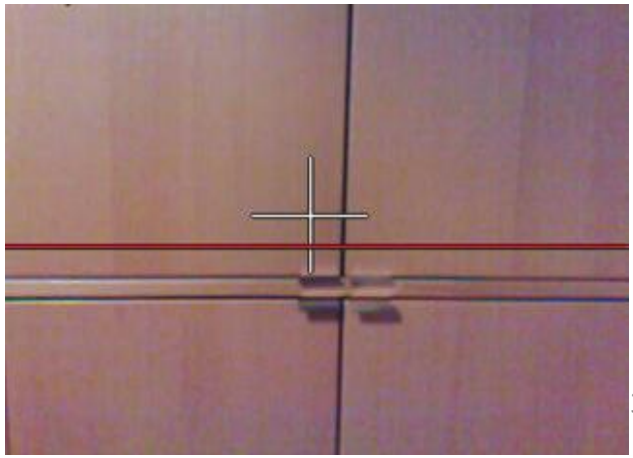
Other interactions

Battery level

- Similar to memory card but used tactile feedback

Levelometer

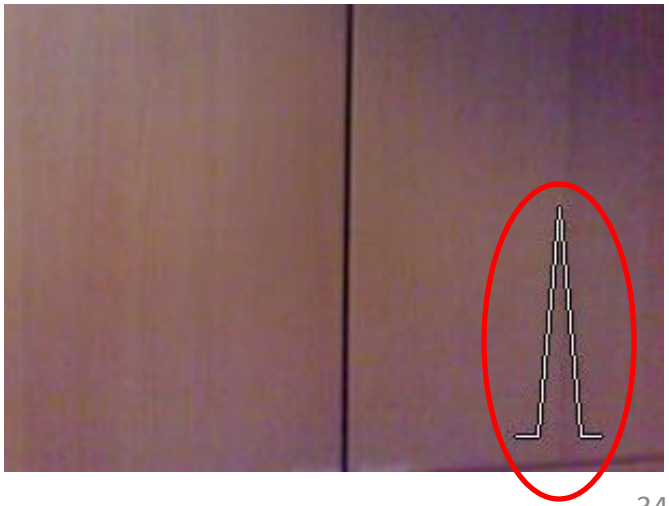
- Allow the user to know when the camera is held level using phone accelerometer
  - Useful when camera is above your head



Stability control

Allow the user to know when the camera is steady enough to take a clear photo

- Phone accelerometer
- Tactile, audio and visual versions



Conclusions

Screens and keyboards are hard to use when mobile

- ‘Head down’ interactions

‘Head up’ multimodal interaction

- Gestures good as input can be ‘hands-free’
- Sound and tactile feedback ‘eyes free’
- Improve performance when mobile

New interaction techniques provide new opportunities and applications

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Demos

New interfaces for digital cameras

Pressure interaction

Tactile feedback for the keyboard

Wrist rotation gestures

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