Lecture #04

S1 –Interaksi Manusia Komputer

KOMPUTER

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Material by: Alan Dix (The author of Human-Computer Interaction book)

The computer

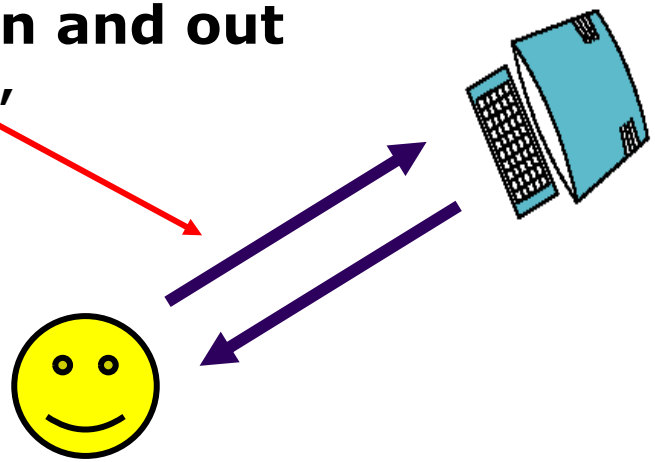
- a computer system is made up of various elements
- each of these elements affects the interaction
  - input devices – text entry and pointing
  - output devices – screen (small&large), digital paper
  - virtual reality – special interaction and display devices
  - physical interaction – e.g. sound, haptic, bio-sensing
  - paper – as output (print) and input (scan)
  - memory – RAM & permanent media, capacity & access
  - processing – speed of processing, networks

Interacting with computers

to understand human–*computer* interaction

… need to understand computers!

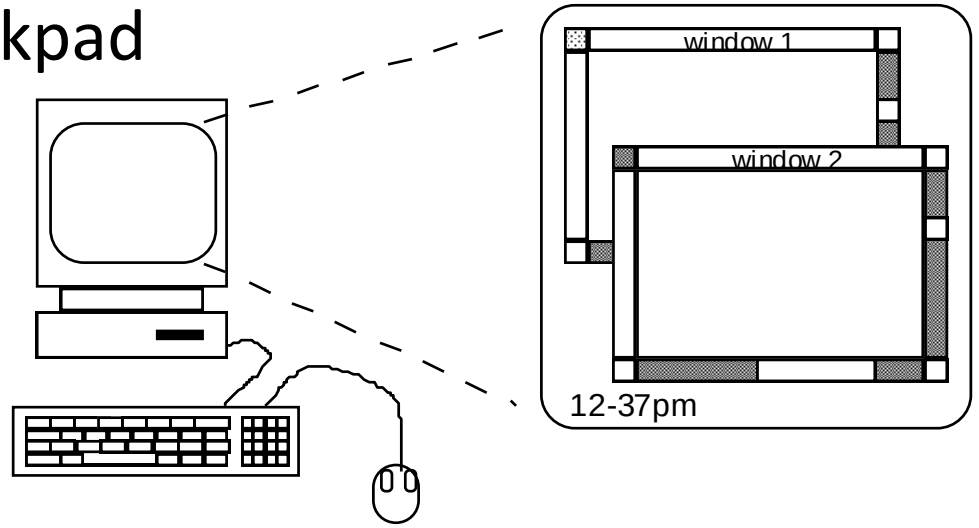
what goes in and out
devices, paper, sensors, etc.



what can it do?
memory, processing, networks

A ‘typical’ computer system

- screen, or monitor, on which there are windows
- keyboard
- mouse/trackpad
- variations
  - desktop
  - laptop
  - PDA



the devices dictate the styles of interaction that the system supports

For different devices, then the interface will support a different style of interaction

How many …

computers in your house?
hands up, …
… none, 1, 2 , 3, more!!

computers in your pockets?

are you thinking …
… PC, laptop, PDA ??

How many computers …

in your house?

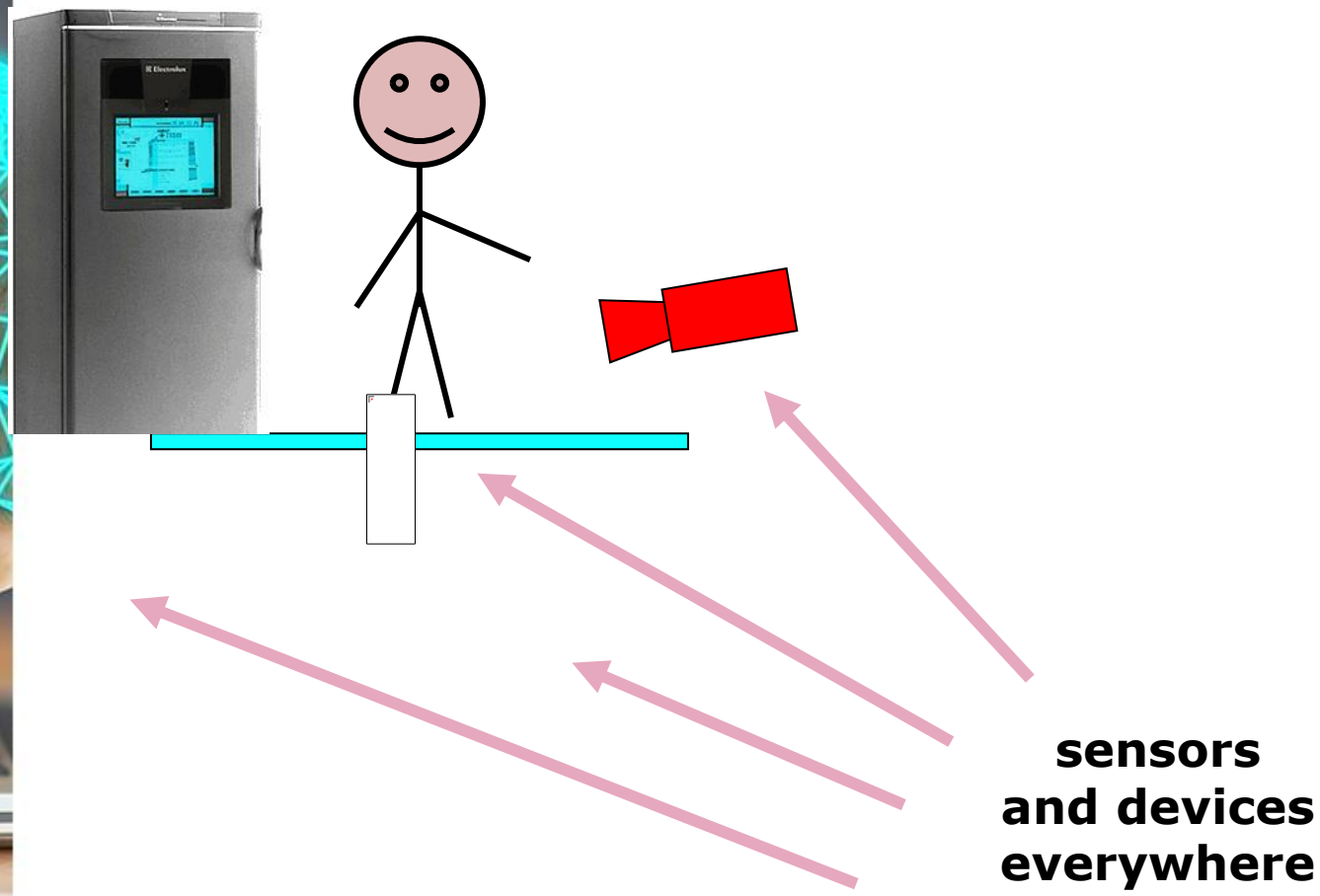
- PC
- TV, VCR, DVD, HiFi, cable/satellite TV
- microwave, cooker, washing machine
- central heating
- security system

can you think of more?

in your pockets?

- PDA
- phone, camera
- smart card, card with magnetic strip?
- electronic car key
- USB memory

try your pockets and bags



sensors and devices everywhere

text entry devices

keyboards (QWERTY et al.)

chord keyboards, phone pads

handwriting, speech

Keyboards

- Most common text input device
- Allows rapid entry of text by experienced users

- Keypress closes connection, causing a character code to be sent
- Usually connected by cable, but can be wireless

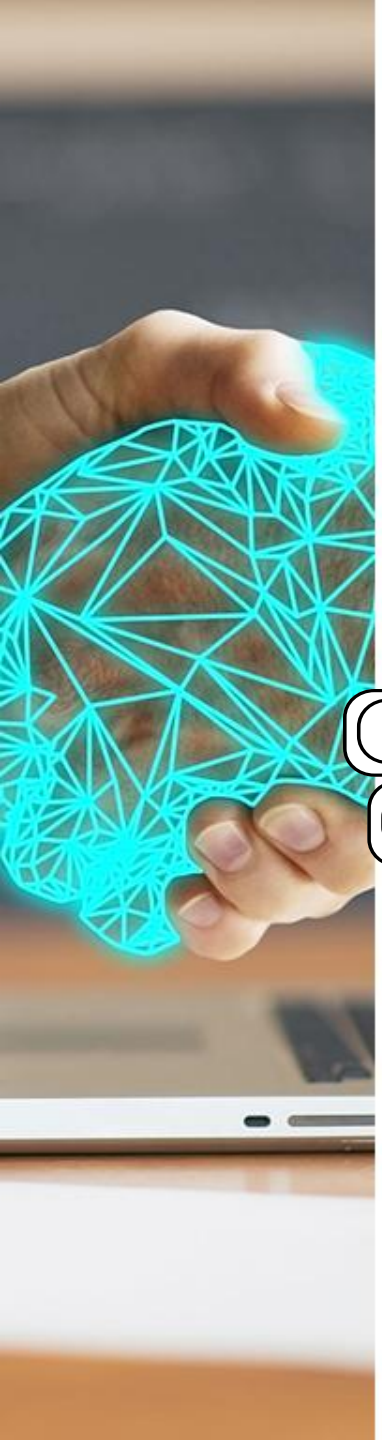
layout – QWERTY

- Standardised layout

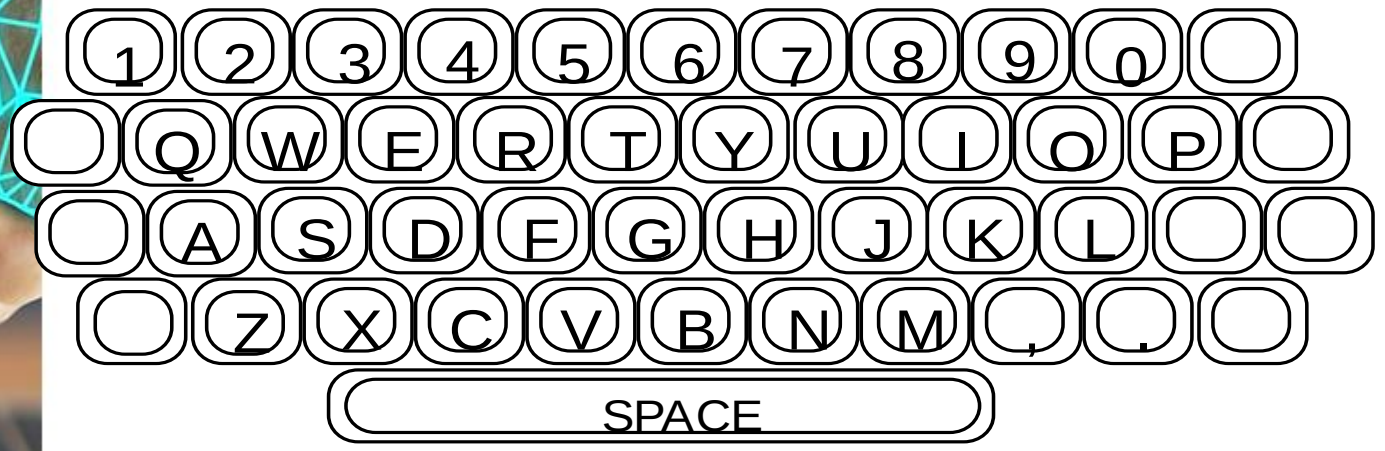
  but …
  - non-alphanumeric keys are placed differently
  - accented symbols needed for different scripts
  - minor differences between UK and USA keyboards

- QWERTY arrangement not optimal for typing
  - layout to prevent typewriters jamming!
- Alternative designs allow faster typing but large social base of QWERTY typists produces reluctance to change.

Lay out QWERTY



QWERTY (ctd)



alternative keyboard layouts

Alphabetic

- keys arranged in alphabetic order
- not faster for trained typists
- not faster for beginners either!

Dvorak

- common letters under dominant fingers
- biased towards right hand
- common combinations of letters alternate between hands
- 10-15% improvement in speed and reduction in fatigue
- But - large social base of QWERTY typists produce market pressures not to change

special keyboards

- designs to reduce fatigue for RSI (Repetitive Strain Injury)
- for one handed use

    e.g. the Maltron left-handed keyboard

Chord keyboards

only a few keys - four or 5

letters typed as combination of keypresses

compact size

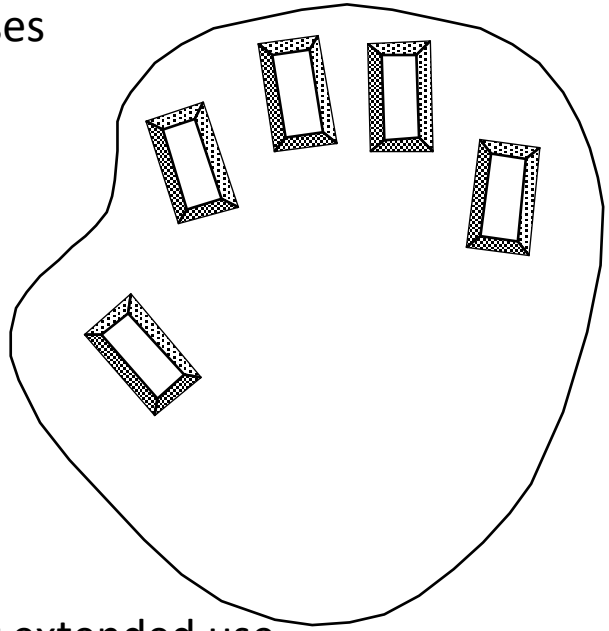
- ideal for portable applications

short learning time

- keypresses reflect letter shape

fast

- once you have trained



BUT - social resistance, plus fatigue after extended use

NEW – niche market for some wearables

phone pad and T9 entry

- use numeric keys with multiple presses

  2 – a b c 6 - m n o
  3 - d e f 7 - p q r s
  4 - g h i 8 - t u v
  5 - j k l 9 - w x y z

  hello = 4433555[pause]555666

  surprisingly fast!

- T9 predictive entry
  - type as if single key for each lett
  - use dictionary to ‘guess’ the right word
  - hello = 43556 …
  - but 26 -> menu ‘am’ or ‘an’

Handwriting recognition

- Text can be input into the computer, using a pen and a digesting tablet
  - natural interaction
- Technical problems:
  - capturing all useful information - stroke path, pressure, etc. in a natural manner
  - segmenting joined up writing into individual letters
  - interpreting individual letters
  - coping with different styles of handwriting
- Used in PDAs, and tablet computers …
  … leave the keyboard on the desk!

Speech recognition

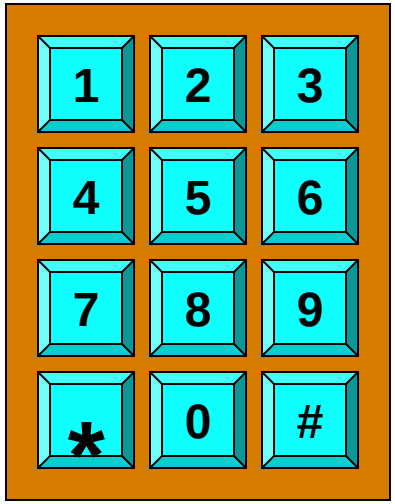
- Improving rapidly
- Most successful when:
  - single user – initial training and learns peculiarities
  - limited vocabulary systems
- Problems with
  - external noise interfering
  - imprecision of pronunciation
  - large vocabularies
  - different speakers

Numeric keypads

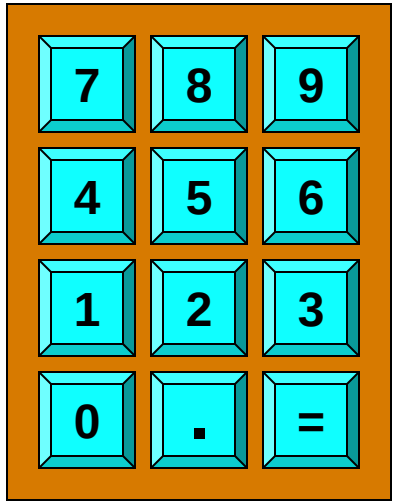
- for entering numbers quickly:
  - calculator, PC keyboard
- for telephones

not the same!!

ATM like phone



telephone



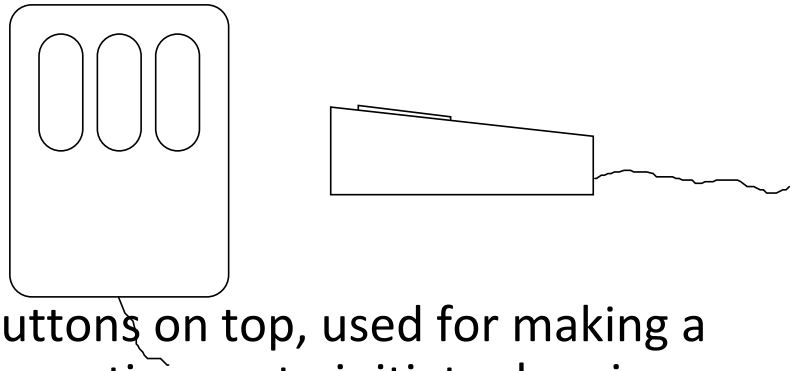
calculator

positioning, pointing and drawing

mouse, touchpad
trackballs, joysticks etc.
touch screens, tablets
eyegaze, cursors

the Mouse

- Handheld pointing device
  - very common
  - easy to use



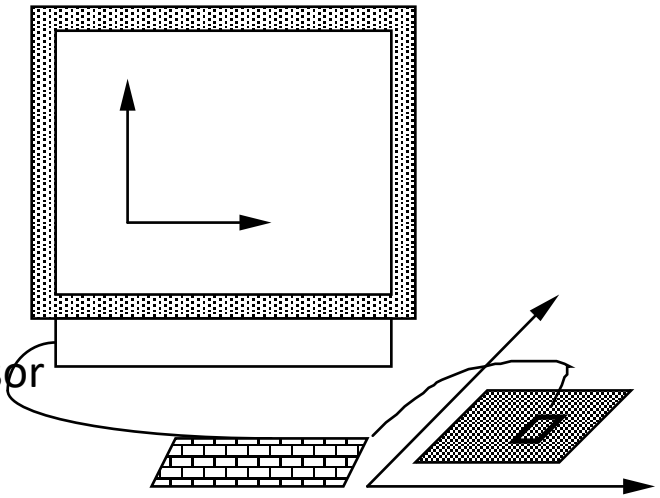
- Two characteristics
  - planar movement
  - buttons

    (usually from 1 to 3 buttons on top, used for making a selection, indicating an option, or to initiate drawing etc.)

the mouse (ctd)

Mouse located on desktop

- requires physical space
- no arm fatigue



Relative movement only is detectable.

Movement of mouse moves screen cursor

Screen cursor oriented in (x, y) plane,
mouse movement in (x, z) plane …

… an *indirect* manipulation device.

- device itself doesn't obscure screen, is accurate and fast.
- hand-eye coordination problems for novice users

How does it work?

Two methods for detecting motion

- Mechanical
  - Ball on underside of mouse turns as mouse is moved
  - Rotates orthogonal potentiometers
  - Can be used on almost any flat surface
- Optical
  - light emitting diode on underside of mouse
  - may use special grid-like pad or just on desk
  - less susceptible to dust and dirt
  - detects fluctuating alterations in reflected light intensity to calculate relative motion in (x, z) plane

Even by foot …

- some experiments with the *footmouse*
  - controlling mouse movement with feet …
  - not very common :-)
- but foot controls are common elsewhere:
  - car pedals
  - sewing machine speed control
  - organ and piano pedals

Touchpad

- small touch sensitive tablets
- ‘stroke’ to move mouse pointer
- used mainly in laptop computers

- good ‘acceleration’ settings important
  - fast stroke
    - lots of pixels per inch moved
    - initial movement to the target
  - slow stroke
    - less pixels per inch
    - for accurate positioning

Trackball and thumbwheels

Trackball

- ball is rotated inside static housing
  - like an upsdie down mouse!
- relative motion moves cursor
- indirect device, fairly accurate
- separate buttons for picking
- very fast for gaming
- used in some portable and notebook computers.

Thumbwheels …

- for accurate CAD – two dials for X-Y cursor position
- for fast scrolling – single dial on mouse

Joystick and keyboard nipple

Joystick

- indirect
  pressure of stick = velocity of movement
- buttons for selection
  on top or on front like a trigger
- often used for computer games
  aircraft controls and 3D navigation

Keyboard nipple

- for laptop computers
- miniature joystick in the middle of the keyboard

Touch-sensitive screen

- Detect the presence of finger or stylus on the screen.
  - works by interrupting matrix of light beams, capacitance changes or ultrasonic reflections
  - *direct* pointing device
- Advantages:
  - fast, and requires no specialised pointer
  - good for menu selection
  - suitable for use in hostile environment: clean and safe from damage.
- Disadvantages:
  - finger can mark screen
  - imprecise (finger is a fairly blunt instrument!)
    - difficult to select small regions or perform accurate drawing
  - lifting arm can be tiring

Stylus and light pen

Stylus

- small pen-like pointer to draw directly on screen
- may use touch sensitive surface or magnetic detection
- used in PDA, tablets PCs and drawing tables

Light Pen

- now rarely used
- uses light from screen to detect location

BOTH …

- very direct and obvious to use
- but can obscure screen

Digitizing tablet

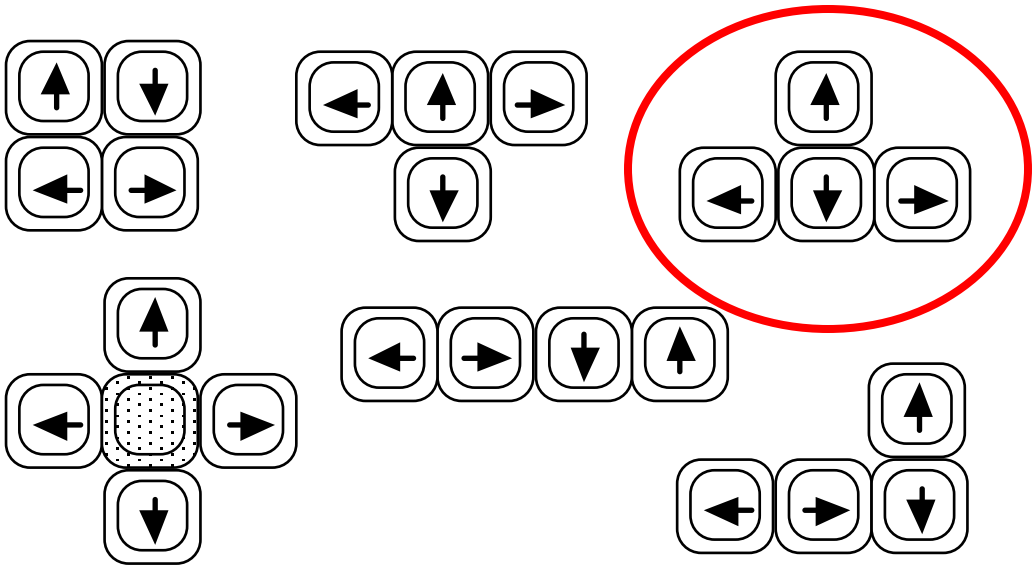
- Mouse like-device with cross hairs
- used on special surface
  - rather like stylus
- very accurate
  - used for digitizing maps

Eyegaze

- control interface by eye gaze direction
  - e.g. look at a menu item to select it
- uses laser beam reflected off retina
  - … a very low power laser!
- mainly used for evaluation (ch x)
- potential for hands-free control
- high accuracy requires headset
- cheaper and lower accuracy devices available
  sit under the screen like a small webcam

Cursor keys

- Four keys (up, down, left, right) on keyboard.
- Very, very cheap, but slow.
- Useful for not much more than basic motion for text-editing tasks.
- No standardised layout, but inverted “T”, most common



Discrete positioning controls

- in phones, TV controls etc.
  - cursor pads or mini-joysticks
  - discrete left-right, up-down
  - mainly for menu selection

display devices

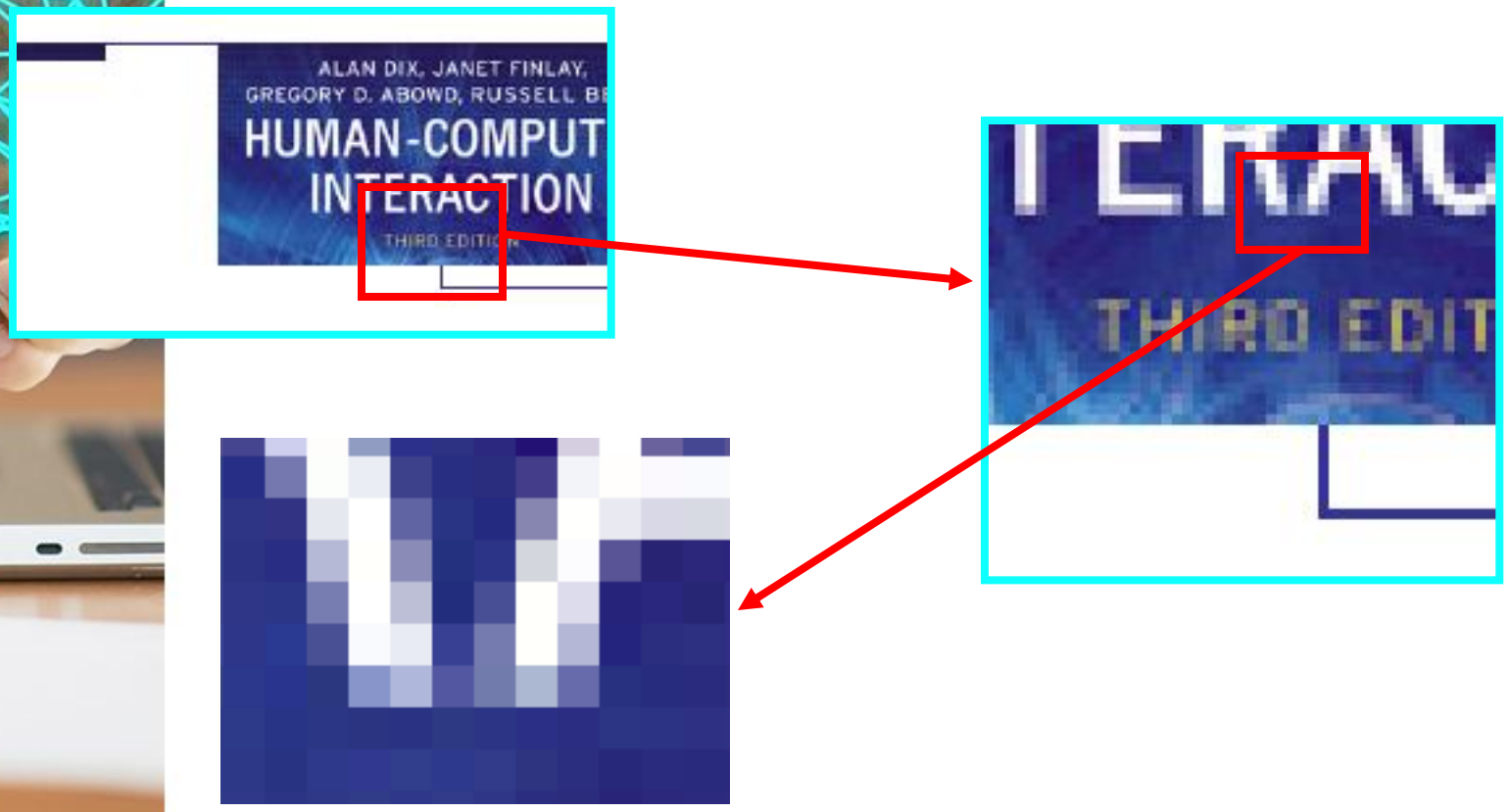
bitmap screens (CRT & LCD)

large & situated displays

digital paper

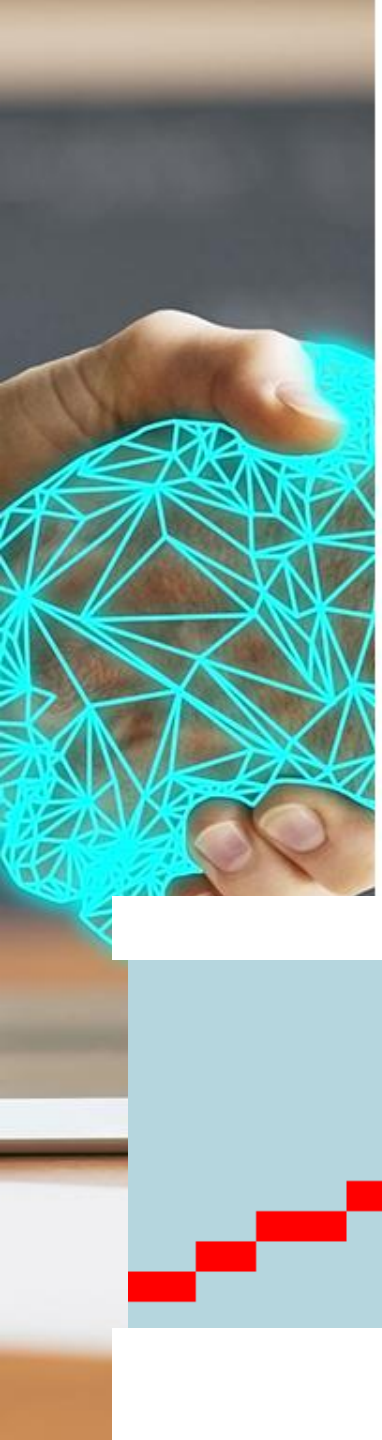
bitmap displays

- screen is vast number of coloured dots



resolution and colour depth

- Resolution … used (inconsistently) for
  - number of pixels on screen (width x height)
    - e.g. SVGA 1024 x 768, PDA perhaps 240x400
  - density of pixels (in pixels or dots per inch - dpi)
    - typically between 72 and 96 dpi
- Aspect ratio
  - ration between width and height
  - 4:3 for most screens, 16:9 for wide-screen TV
- Colour depth:
  - how many different colours for each pixel?
  - black/white or greys only
  - 256 from a pallete
  - 8 bits each for red/green/blue = millions of colours



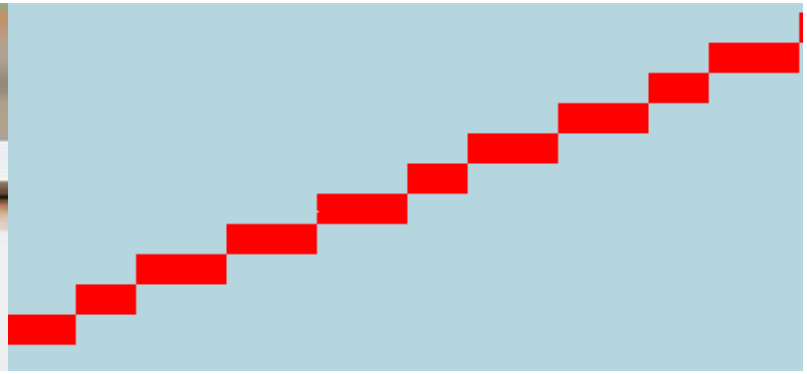
anti-aliasing

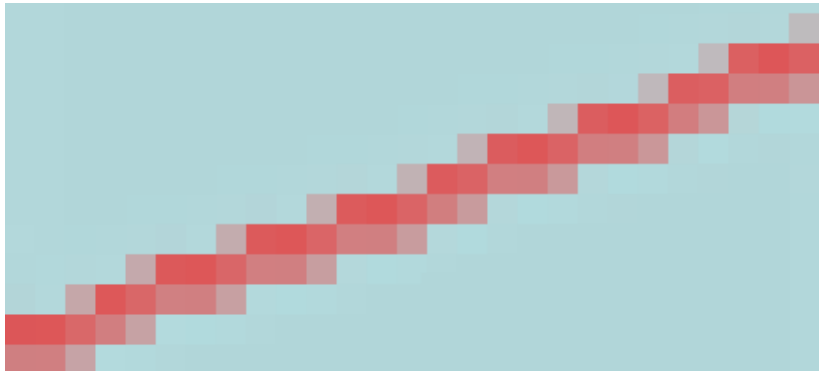
Jaggies

- diagonal lines that have discontinuities in due to horizontal raster scan process.

Anti-aliasing

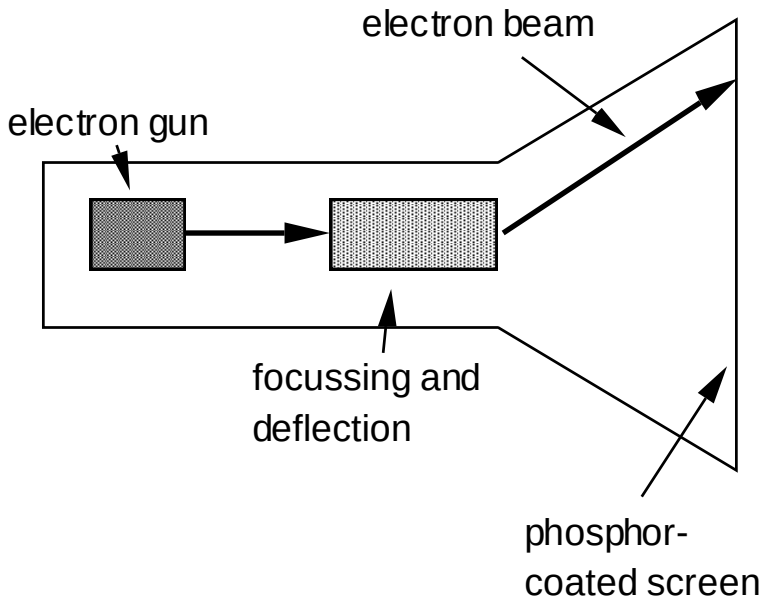
- softens edges by using shades of line colour
- also used for text





Cathode ray tube

- Stream of electrons emitted from electron gun, focused and directed by magnetic fields, hit phosphor-coated screen which glows
- used in TVs and computer monitors



Health hazards of CRT !

- X-rays: largely absorbed by screen (but not at rear!)
- UV- and IR-radiation from phosphors: insignificant levels
- Radio frequency emissions, plus ultrasound (~16kHz)
- Electrostatic field - leaks out through tube to user. Intensity dependant on distance and humidity. Can cause rashes.
- Electromagnetic fields (50Hz-0.5MHz). Create induction currents in conductive materials, including the human body. Two types of effects attributed to this: visual system - high incidence of cataracts in VDU operators, and concern over reproductive disorders (miscarriages and birth defects).

Health hints …

- do not sit too close to the screen
- do not use very small fonts
- do not look at the screen for long periods without a break
- do not place the screen directly in front of a bright window
- work in well-lit surroundings

★ Take extra care if pregnant.
but also posture, ergonomics, stress

Liquid crystal displays

- Smaller, lighter, and … no radiation problems.
- Found on PDAs, portables and notebooks,
  … and increasingly on desktop and even for home TV
- also used in dedicted displays:
  digital watches, mobile phones, HiFi controls
- How it works …
  - Top plate transparent and polarised, bottom plate reflecting.
  - Light passes through top plate and crystal, and reflects back to eye.
  - Voltage applied to crystal changes polarisation and hence colour
  - N.B. light reflected not emitted => less eye strain

special displays

Random Scan (Directed-beam refresh, vector display)

- draw the lines to be displayed directly
- no jaggies
- lines need to be constantly redrawn
- rarely used except in special instruments

Direct view storage tube (DVST)

- Similar to random scan but persistent => no flicker
- Can be incrementally updated but not selectively erased
- Used in analogue storage oscilloscopes

large displays

- used for meetings, lectures, etc.
- technology

  plasma – usually wide screen

  video walls – lots of small screens together

  projected – RGB lights or LCD projector

  - hand/body obscures screen
  - may be solved by 2 projectors + clever software

  back-projected

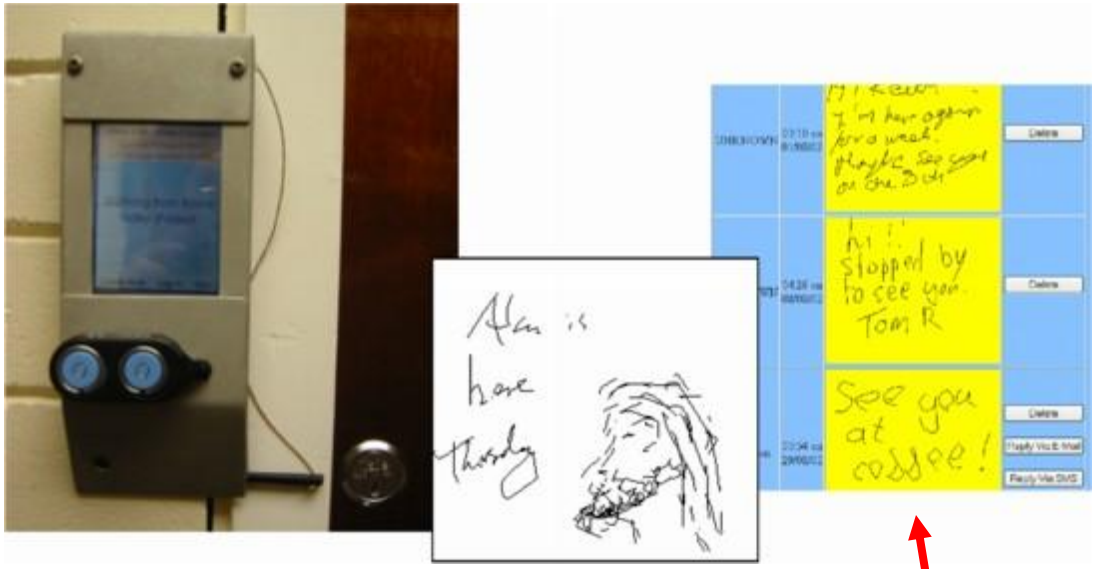
  - frosted glass + projector behind

situated displays

- displays in ‘public’ places
  - large or small
  - very public or for small group
- display only
  - for information relevant to location
- or interactive
  - use stylus, touch sensitive screem
- in all cases … the location matters
  - meaning of information or interaction is related to the location

Hermes a situated display

small displays beside office doors

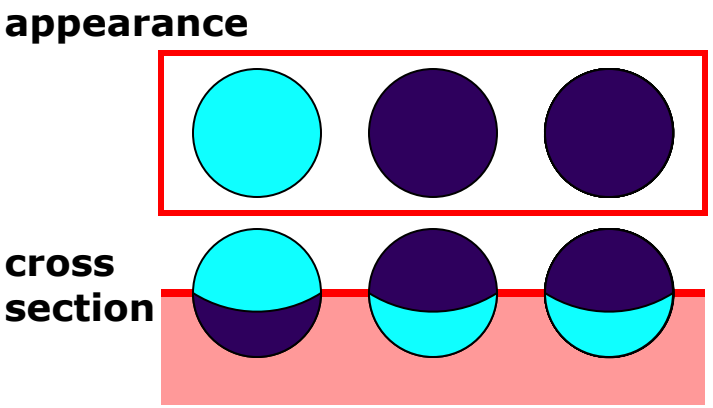


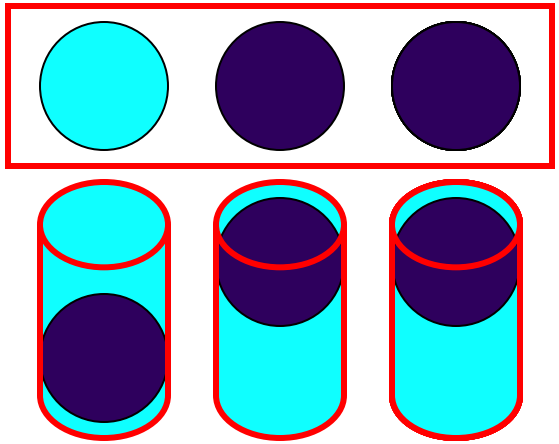
handwritten notes left using stylus

office owner reads notes using web interface

Digital paper

- what?
  - thin flexible sheets
  - updated electronically
  - but retain display
- how?
  - small spheres turned
  - or channels with coloured liquid and contrasting spheres
  - rapidly developing area





virtual reality and 3D interaction

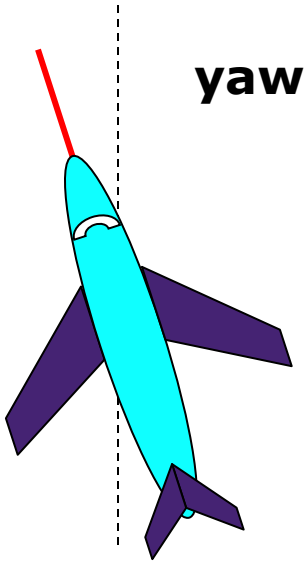
positioning in 3D space
moving and grasping

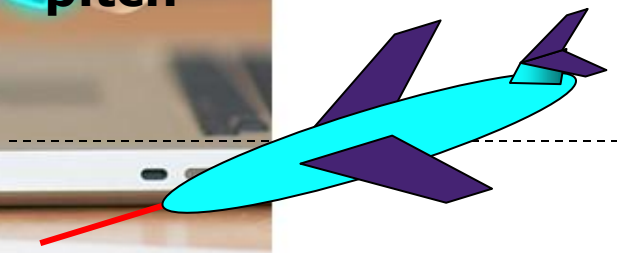
seeing 3D (helmets and caves)

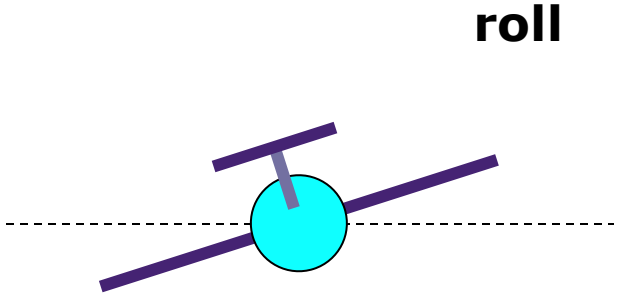
positioning in 3D space

- cockpit and virtual controls
  - steering wheels, knobs and dials … just like real!
- the 3D mouse
  - six-degrees of movement: x, y, z + roll, pitch, yaw
- data glove
  - fibre optics used to detect finger position
- VR helmets
  - detect head motion and possibly eye gaze
- whole body tracking
  - accelerometers strapped to limbs or reflective dots and video processing

pitch, yaw and roll







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- small touch sensitive tablets
- ‘stroke’ to move mouse pointer
- used mainly in laptop computers

- good ‘acceleration’ settings important
  - fast stroke
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Trackball and thumbwheels

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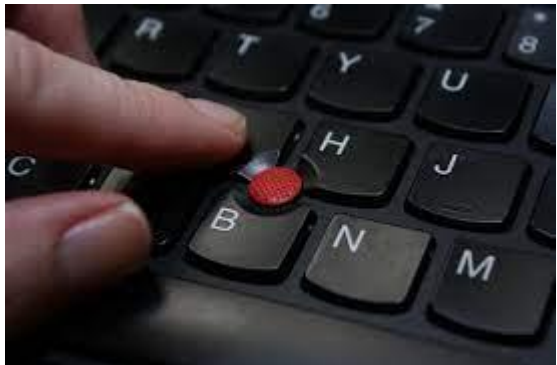

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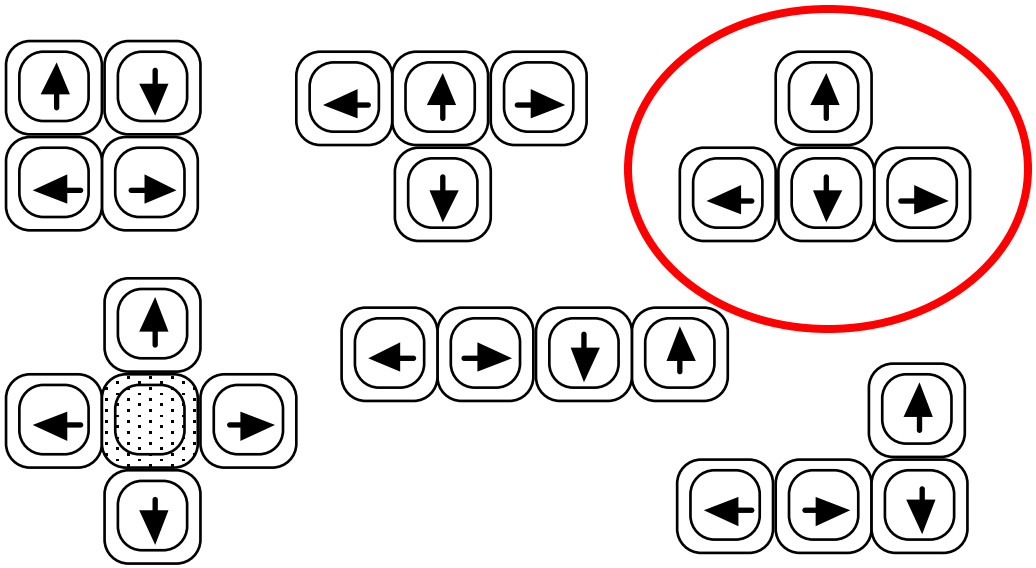

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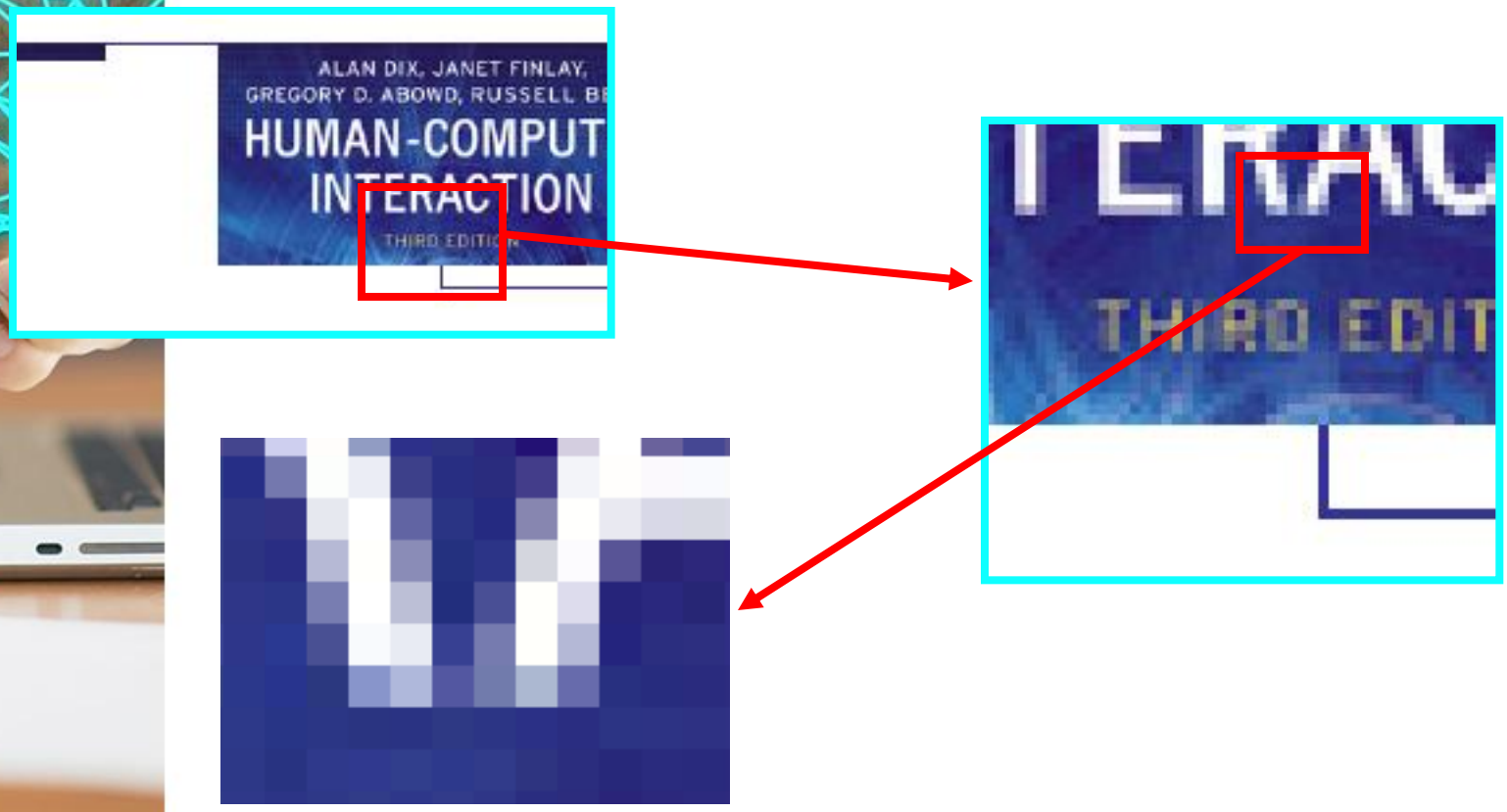

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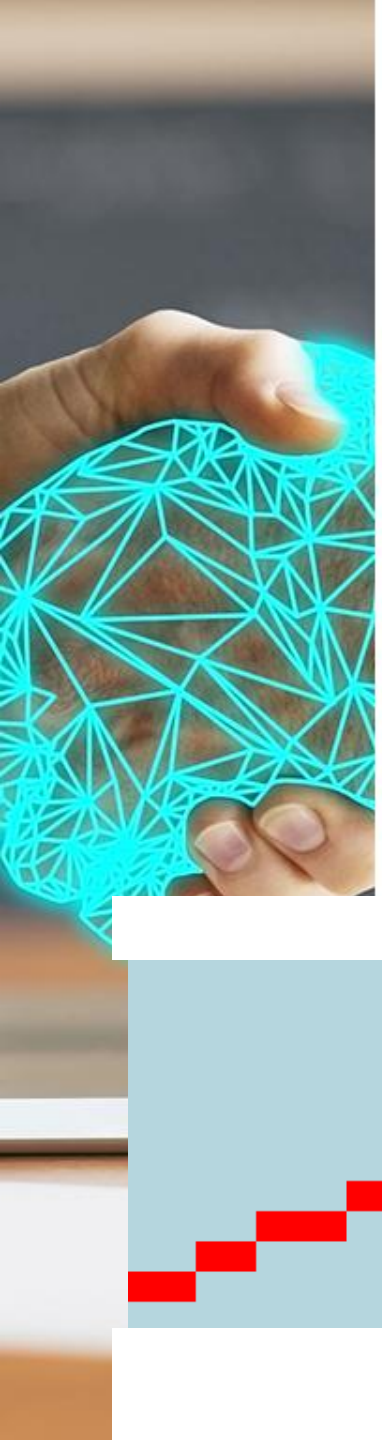

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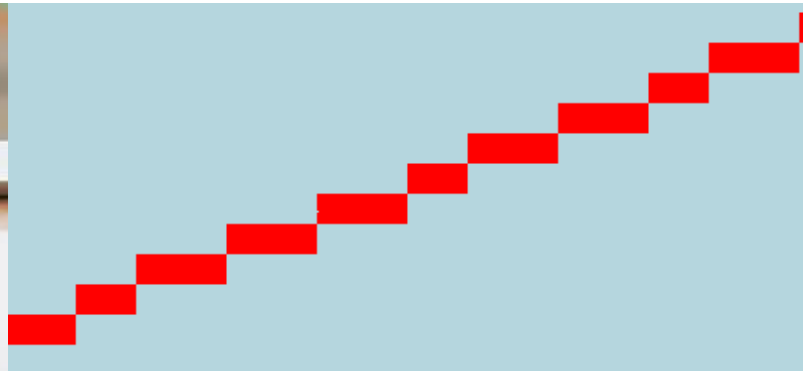
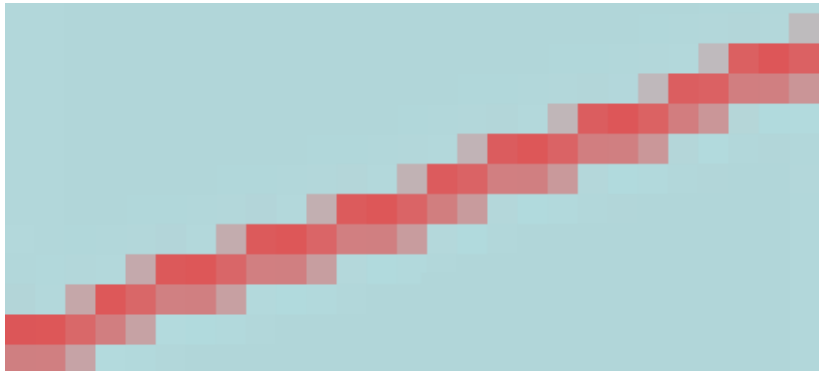
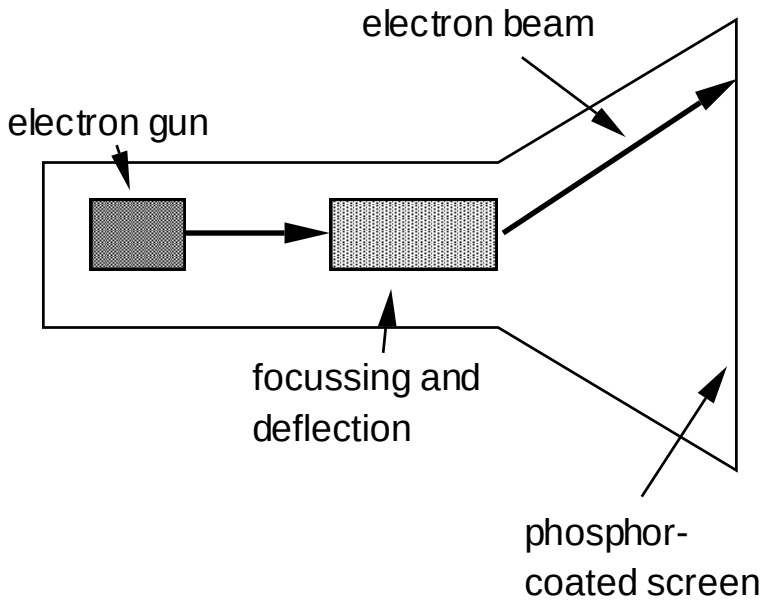
- softens edges by using shades of line colour
- also used for text





Cathode ray tube

- Stream of electrons emitted from electron gun, focused and directed by magnetic fields, hit phosphor-coated screen which glows
- used in TVs and computer monitors



Health hazards of CRT !

- X-rays: largely absorbed by screen (but not at rear!)
- UV- and IR-radiation from phosphors: insignificant levels
- Radio frequency emissions, plus ultrasound (~16kHz)
- Electrostatic field - leaks out through tube to user. Intensity dependant on distance and humidity. Can cause rashes.
- Electromagnetic fields (50Hz-0.5MHz). Create induction currents in conductive materials, including the human body. Two types of effects attributed to this: visual system - high incidence of cataracts in VDU operators, and concern over reproductive disorders (miscarriages and birth defects).

Health hints …

- do not sit too close to the screen
- do not use very small fonts
- do not look at the screen for long periods without a break
- do not place the screen directly in front of a bright window
- work in well-lit surroundings

★ Take extra care if pregnant.
but also posture, ergonomics, stress

Liquid crystal displays

- Smaller, lighter, and … no radiation problems.
- Found on PDAs, portables and notebooks,
  … and increasingly on desktop and even for home TV
- also used in dedicted displays:
  digital watches, mobile phones, HiFi controls
- How it works …
  - Top plate transparent and polarised, bottom plate reflecting.
  - Light passes through top plate and crystal, and reflects back to eye.
  - Voltage applied to crystal changes polarisation and hence colour
  - N.B. light reflected not emitted => less eye strain

special displays

Random Scan (Directed-beam refresh, vector display)

- draw the lines to be displayed directly
- no jaggies
- lines need to be constantly redrawn
- rarely used except in special instruments

Direct view storage tube (DVST)

- Similar to random scan but persistent => no flicker
- Can be incrementally updated but not selectively erased
- Used in analogue storage oscilloscopes

large displays

- used for meetings, lectures, etc.
- technology

  plasma – usually wide screen

  video walls – lots of small screens together

  projected – RGB lights or LCD projector

  - hand/body obscures screen
  - may be solved by 2 projectors + clever software

  back-projected

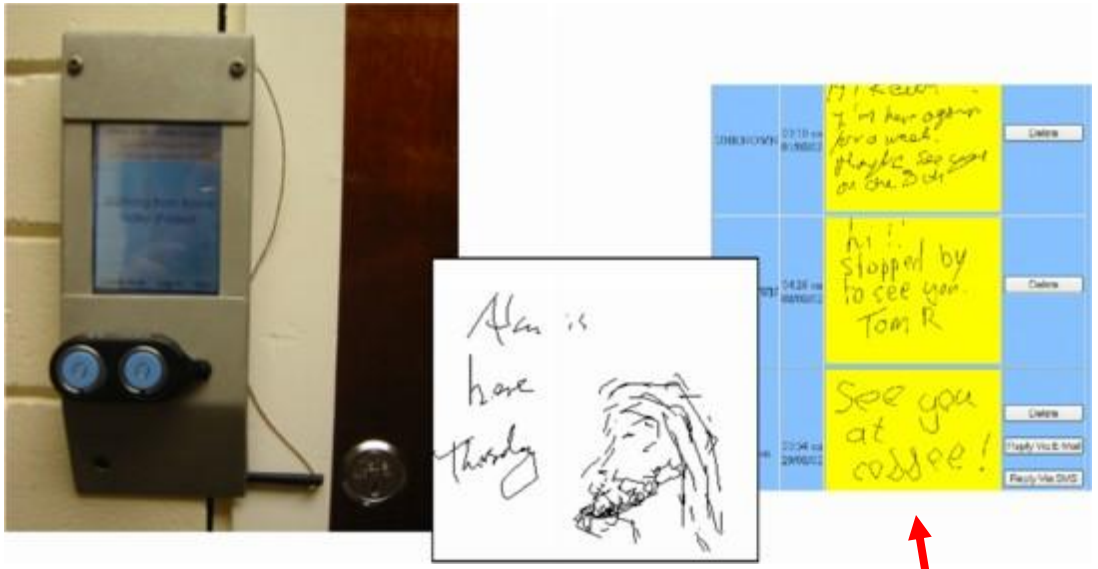
  - frosted glass + projector behind

situated displays

- displays in ‘public’ places
  - large or small
  - very public or for small group
- display only
  - for information relevant to location
- or interactive
  - use stylus, touch sensitive screem
- in all cases … the location matters
  - meaning of information or interaction is related to the location

Hermes a situated display

small displays beside office doors

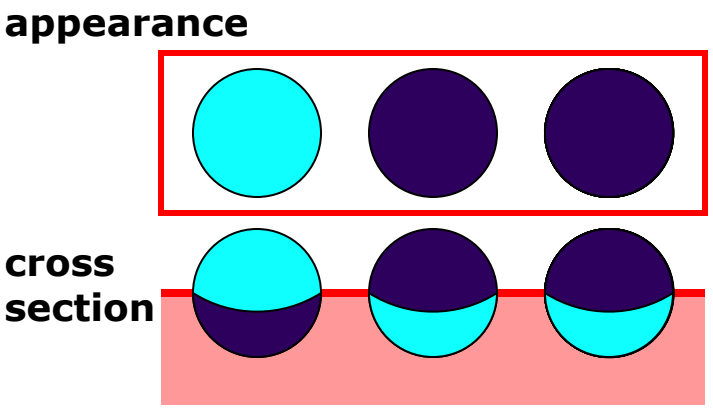


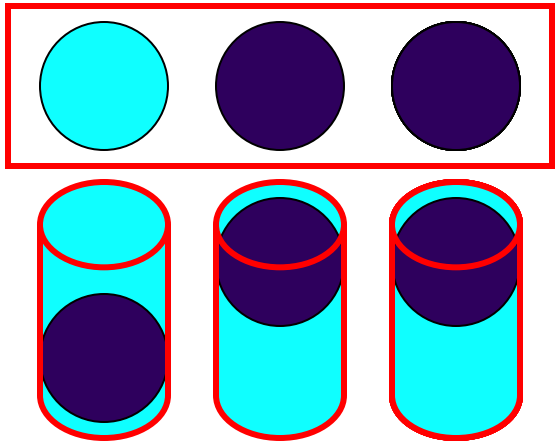
handwritten notes left using stylus

office owner reads notes using web interface

Digital paper

- what?
  - thin flexible sheets
  - updated electronically
  - but retain display
- how?
  - small spheres turned
  - or channels with coloured liquid and contrasting spheres
  - rapidly developing area





virtual reality and 3D interaction

positioning in 3D space
moving and grasping

seeing 3D (helmets and caves)

positioning in 3D space

- cockpit and virtual controls
  - steering wheels, knobs and dials … just like real!
- the 3D mouse
  - six-degrees of movement: x, y, z + roll, pitch, yaw
- data glove
  - fibre optics used to detect finger position
- VR helmets
  - detect head motion and possibly eye gaze
- whole body tracking
  - accelerometers strapped to limbs or reflective dots and video processing

pitch, yaw and roll