

Lecture #04

S1 –Interaksi Manusia Komputer

KOMPUTER

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Informatics Hasanuddin University





The computer

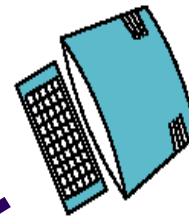
- a computer system is made up of various elements
- each of these elements affects the interaction
 - input devices – text entry and pointing
 - output devices – screen (small&large), digital paper
 - virtual reality – special interaction and display devices
 - physical interaction – e.g. sound, haptic, 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!

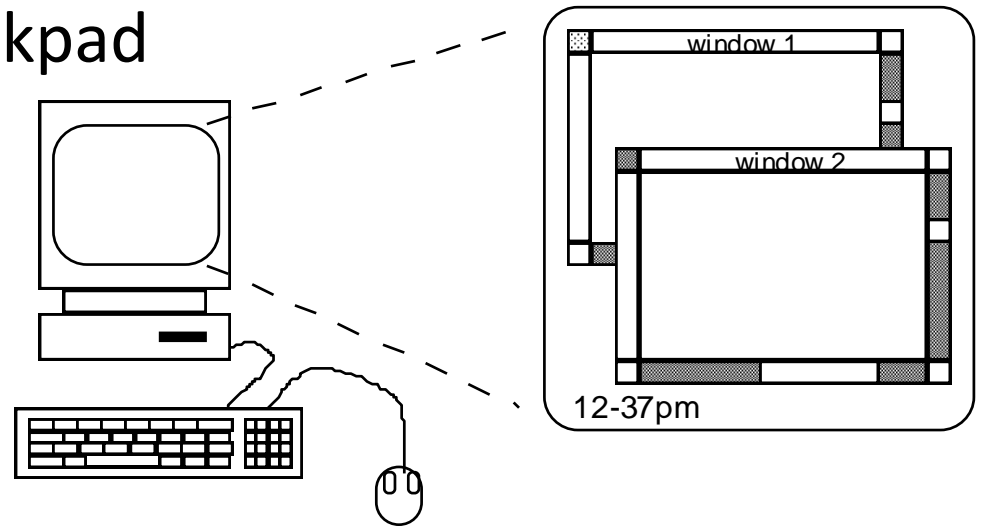
what goes in and out
devices, paper,
sensors, etc.



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

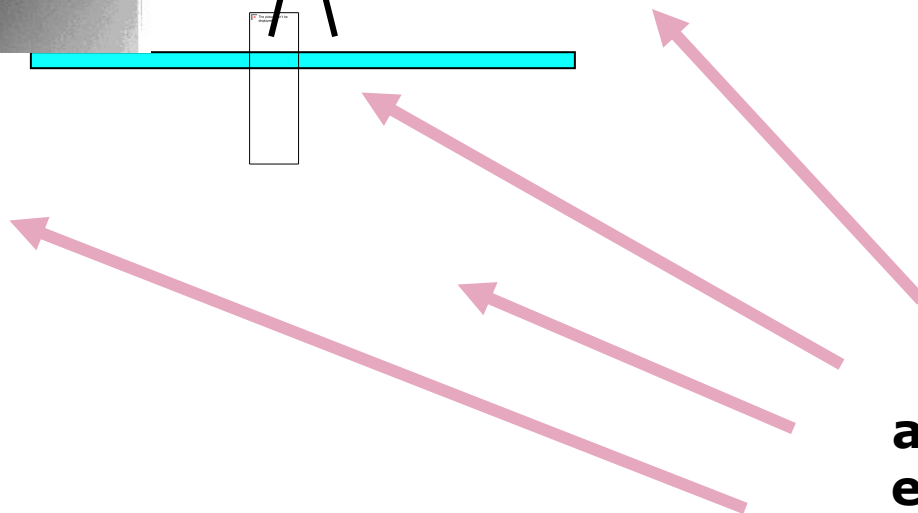
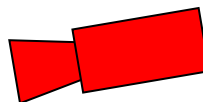
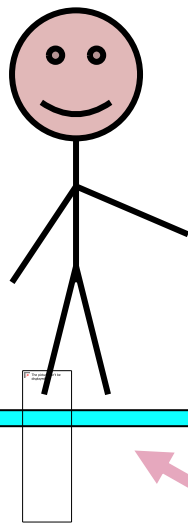
can you think of more?

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





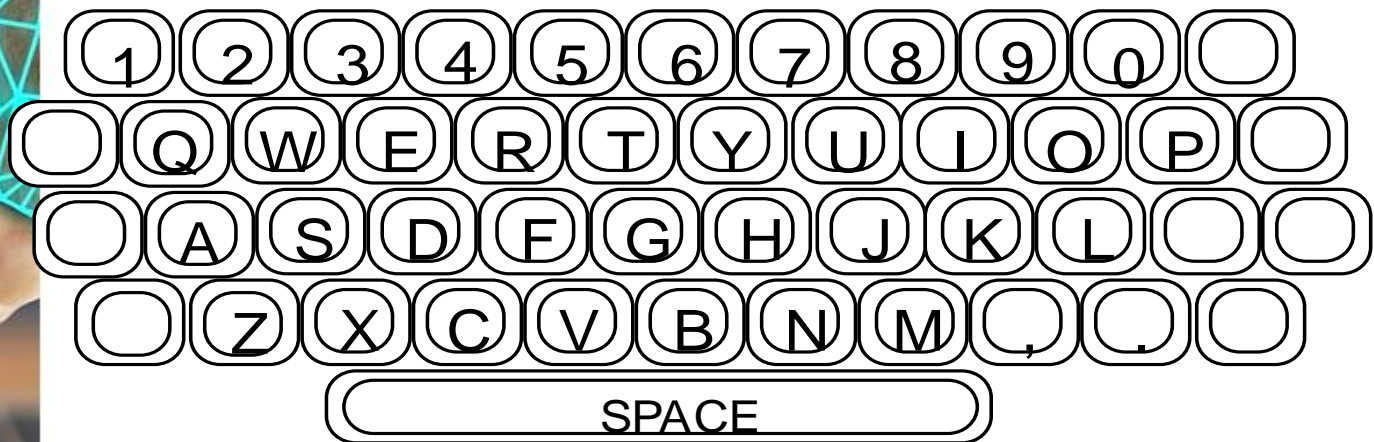
layout – QWERTY

- 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

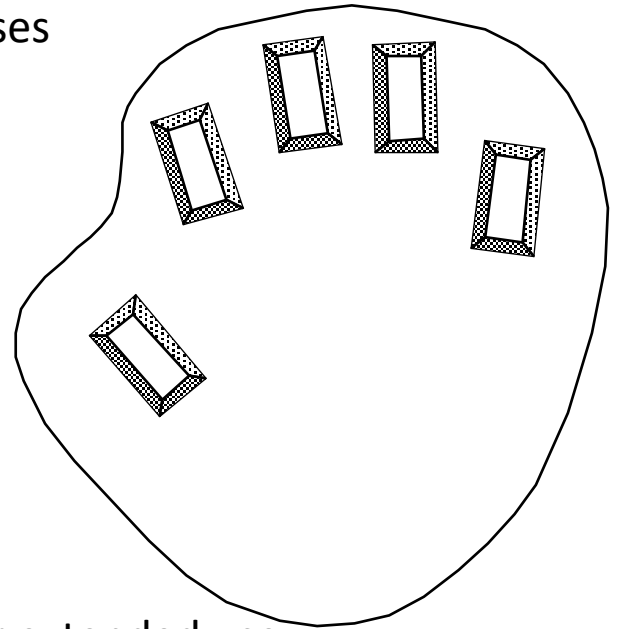
- keypresses reflect letter shape

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 letter
 - 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 digitizing 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

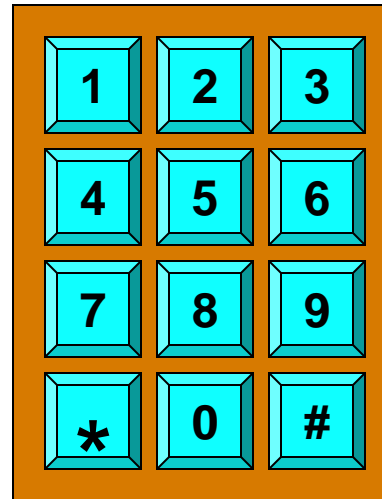
- Improving rapidly
- Most successful when:
 - single user – initial training and learns peculiarities
 - limited vocabulary systems
- Problems with
 - external noise interfering
 - imprecision of pronunciation
 - large vocabularies
 - different speakers

Numeric keypads

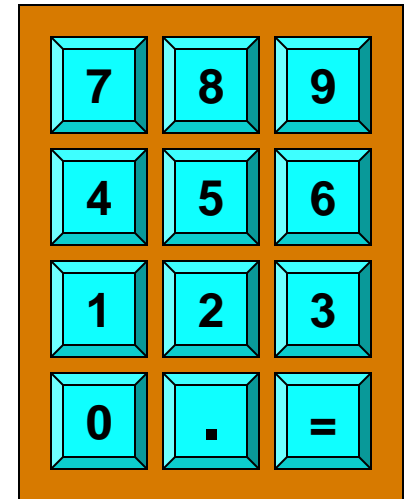
- for entering numbers quickly:
 - calculator, PC keyboard
- for telephones

not the same!!

ATM like phone



telephone



calculator



positioning, pointing and drawing

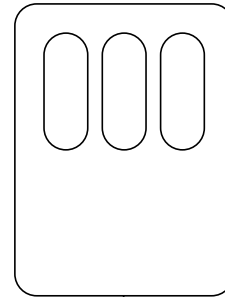
mouse, touchpad
trackballs, joysticks etc.
touch screens, tablets
eyegaze, cursors

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

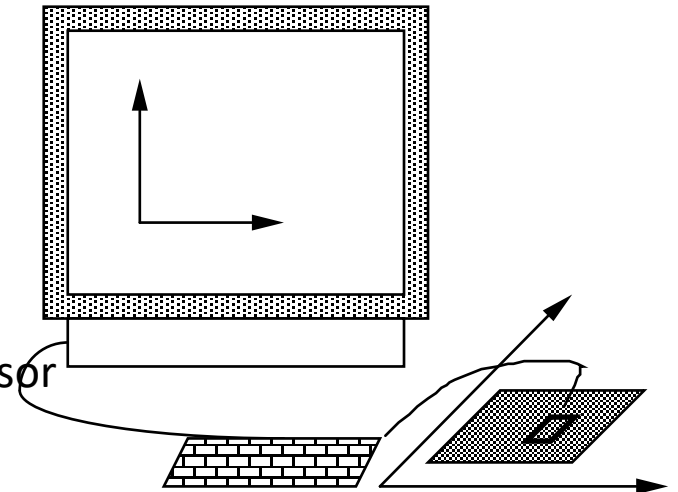
Relative movement only is detectable.

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 upside 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

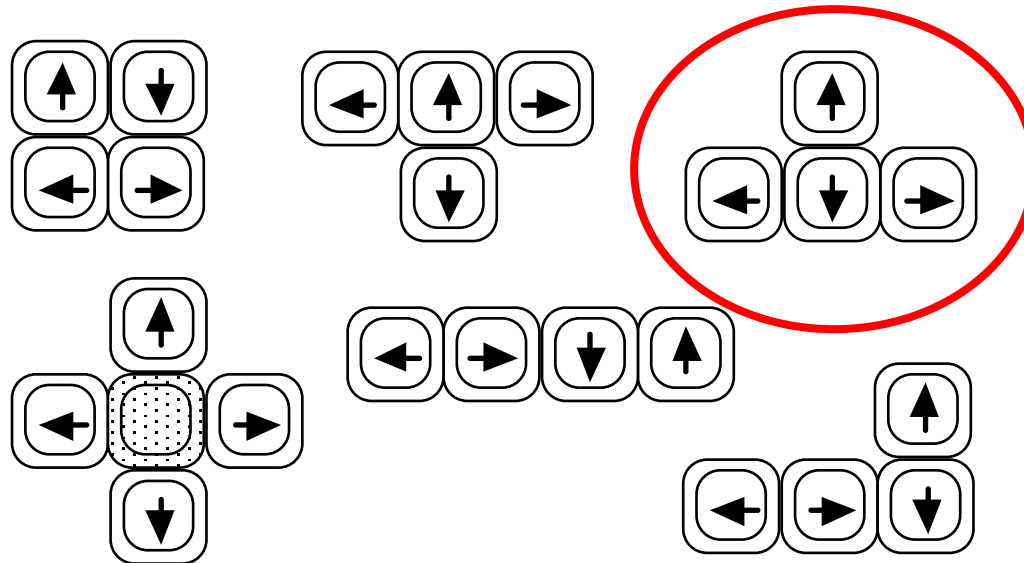
Eyegaze

- 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)

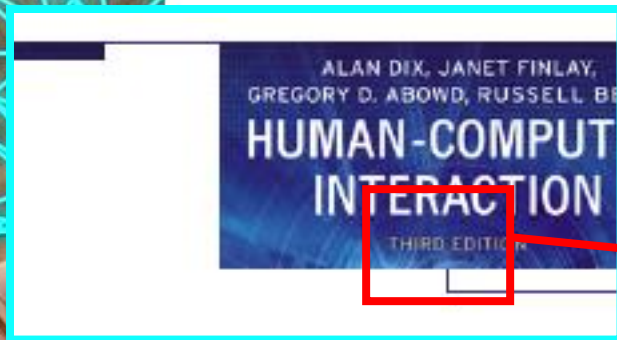
large & situated displays

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



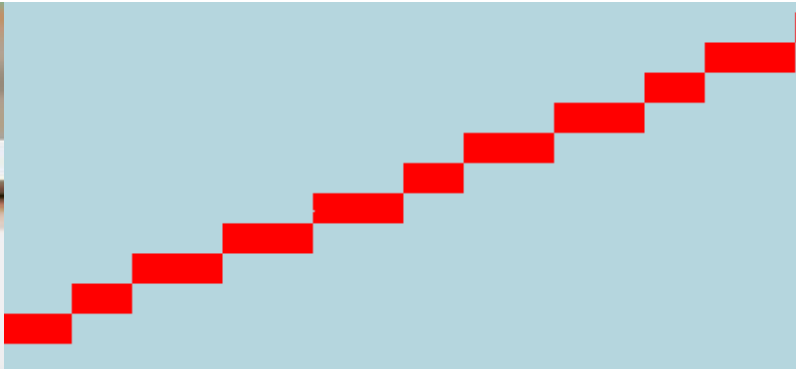
anti-aliasing

Jaggies

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

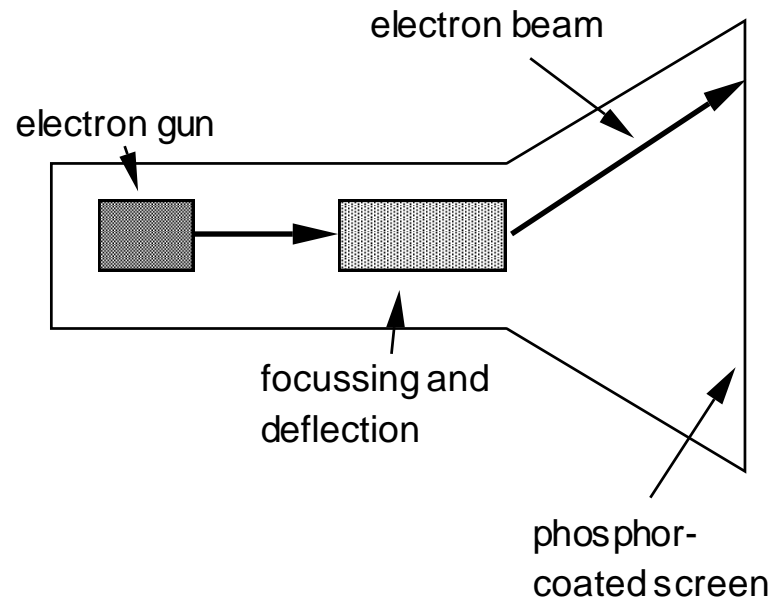
Anti-aliasing

- 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 ($\sim 16\text{kHz}$)
- 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 dedicated 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
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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 screen
- 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**

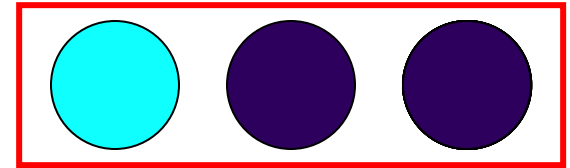


**office owner
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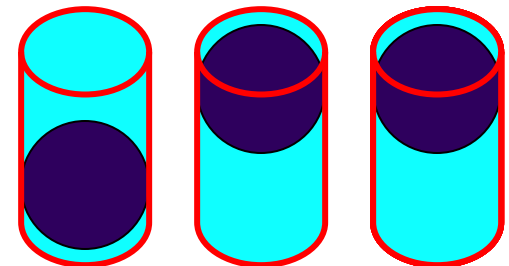
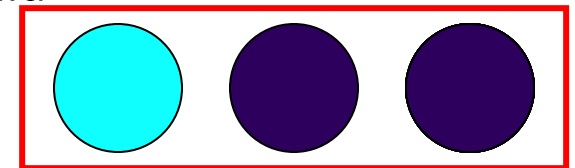
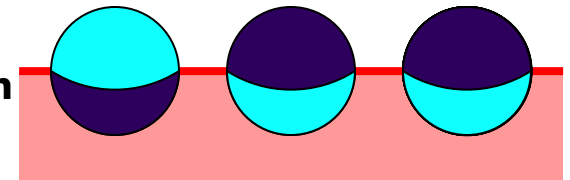
Digital paper

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

appearance



cross section





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

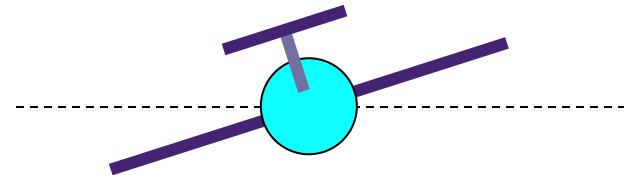
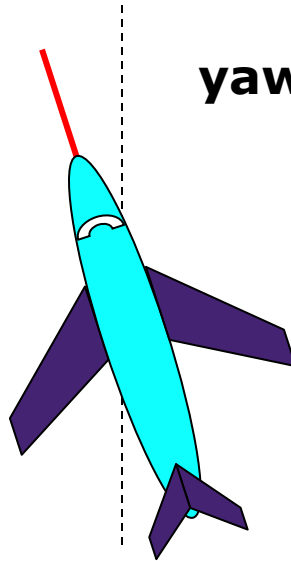
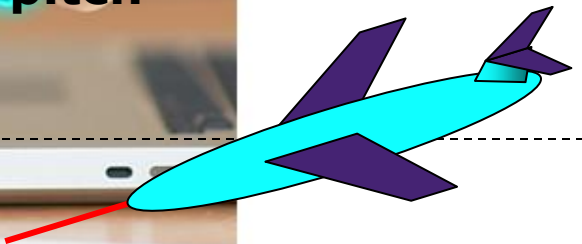
pitch, yaw and roll



pitch

yaw

roll



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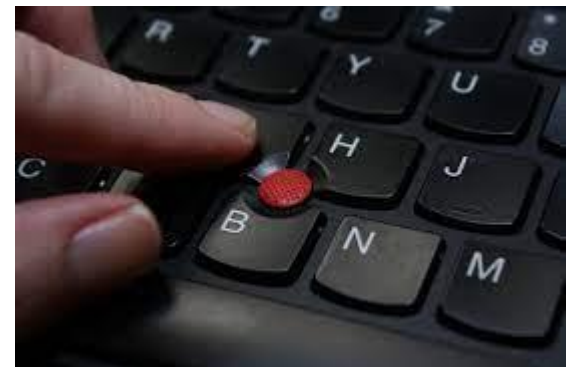
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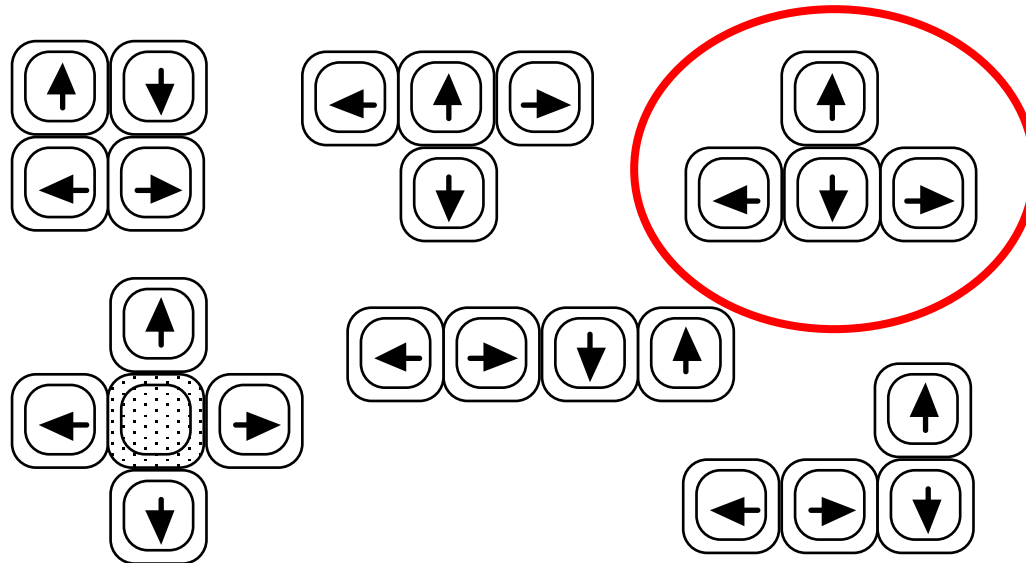
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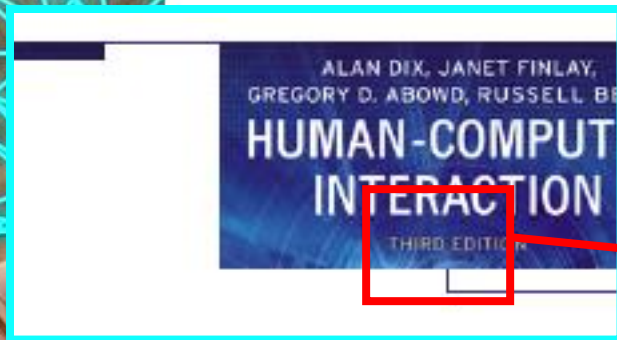
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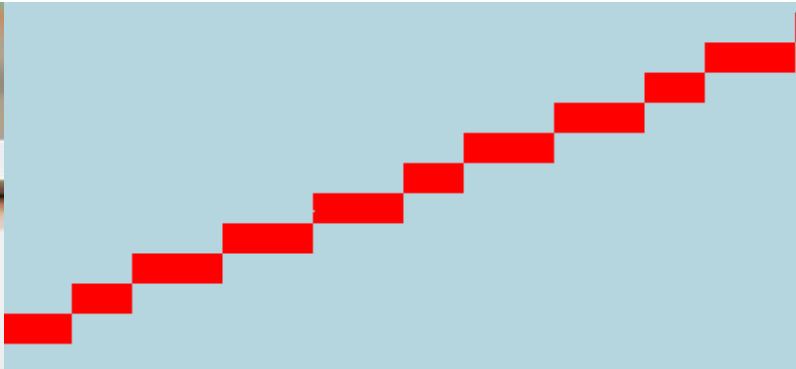
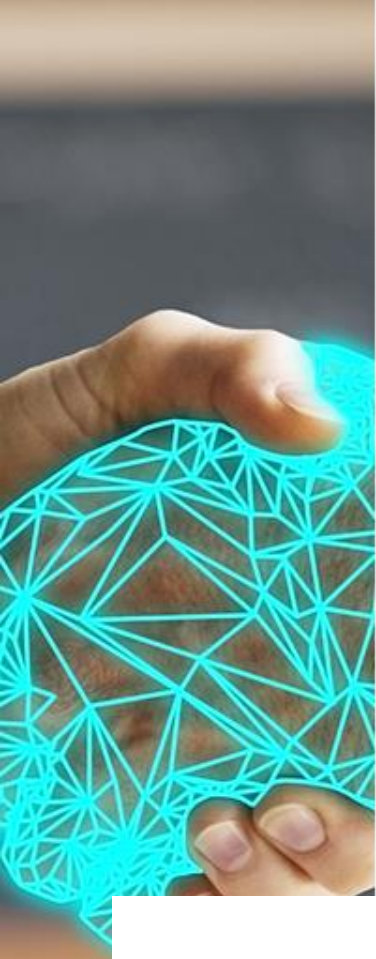
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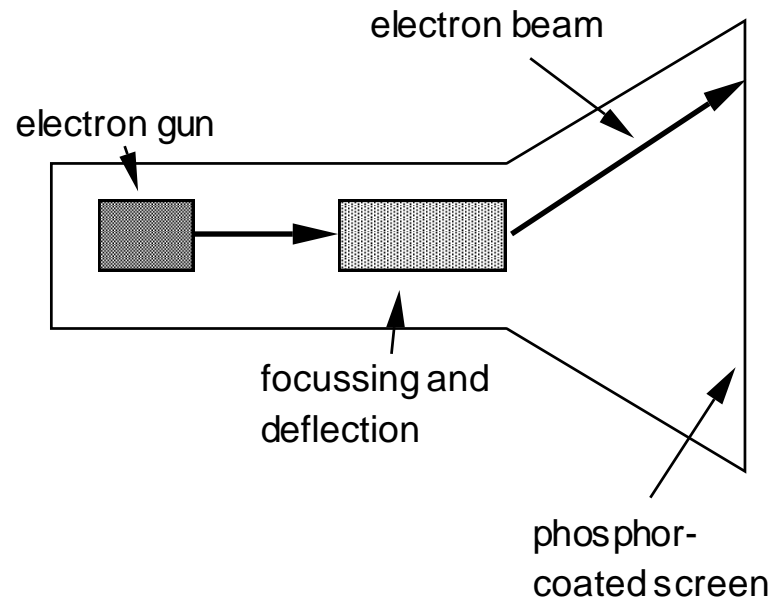
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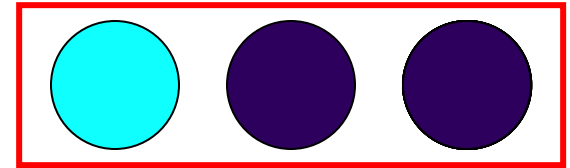


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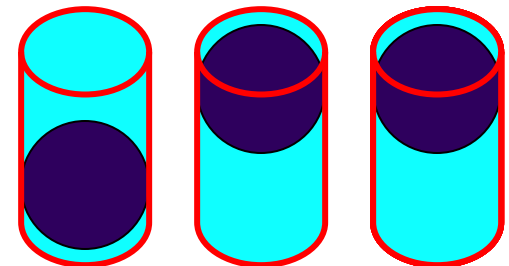
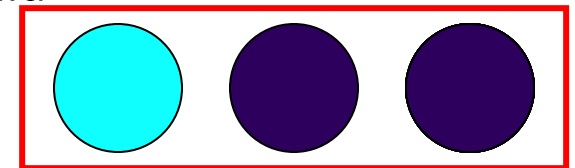
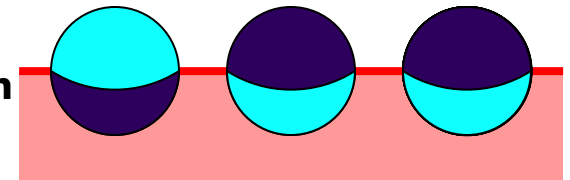
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moving and grasping

seeing 3D (helmets and caves)



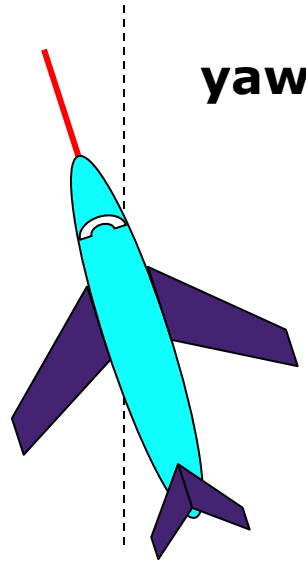
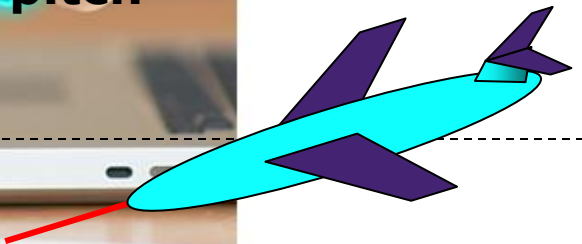
positioning in 3D space

- 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

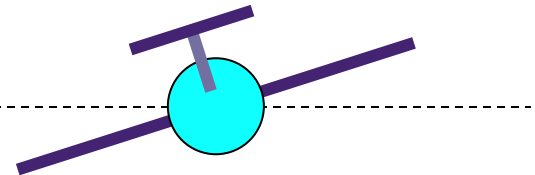
pitch, yaw and roll



pitch



yaw



roll