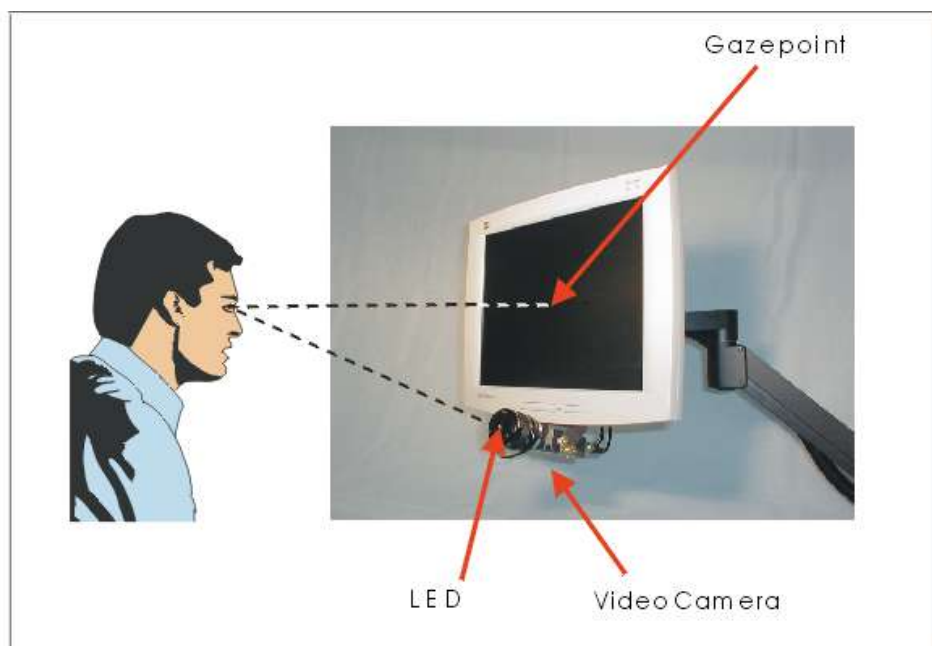# Eyegaze

- **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**
  - potential for hands-free control
  - high accuracy requires headset
  - cheaper and lower accuracy devices available
    sit under the screen like a small webcam

Eyegaze

DANS, KÖN OCH JAGPROJEKT

På jakt efter ungdomars kroppsspråk och den "synkretiska dansen", en sammansmältning av olika kulturers dans, har jag i mitt fältarbete under hösten rört mig på olika arenor inom skolans värld. Nordiska, afrikanska, syd- och östeuropeiska ungdomar gör sina röster hörda genom sång, musik, skrik, skratt och gestaltar känslor och uttryck med hjälp av kroppsspråk och dans.

Den individuella estetiken framträder i kläder, frisyrer och symboliska tecken som förstärker ungdomarnas "jagprojekt" där också den egna stilen i kroppsrörelserna spelar en betydande roll i identitetsprövningen. Uppehållsrummet fungerar som offentlig arena där ungdomarna spelar upp sina performanceliknande kroppsshower

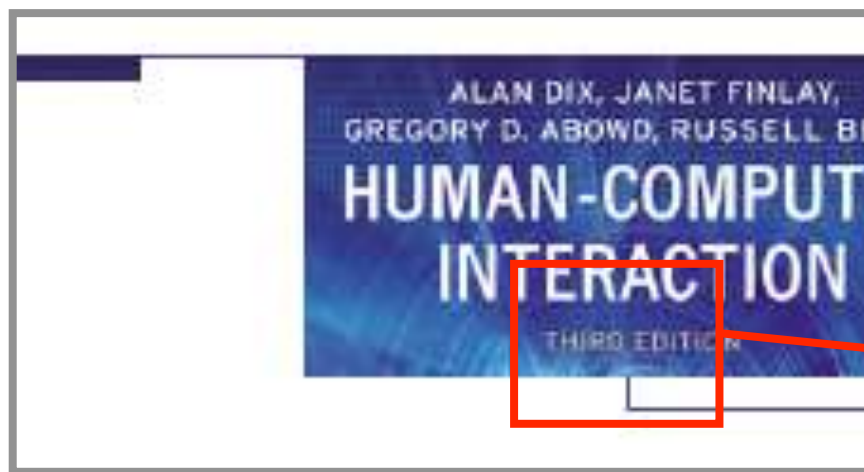# Display Devices

bitmap screens

large & situated displays
digital paper

Bitmap Displays

- Screen is vast number of colored dots

Resolution and Color Depth

- **Resolution …** used (inconsistently) for
  - **number** of pixels on screen (width x height)
    - e.g. UHD 3840 x 2160, 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
- **Color depth:**
  - How many different colors for each pixel?
  - Black/white or greys only
  - 256 from a palette
  - 8 bits each for red/green/blue = millions of colors

1in.

5 Pixels

1 Pixel

5 Pixels

Resolution = 5 DPI (dots per inch)
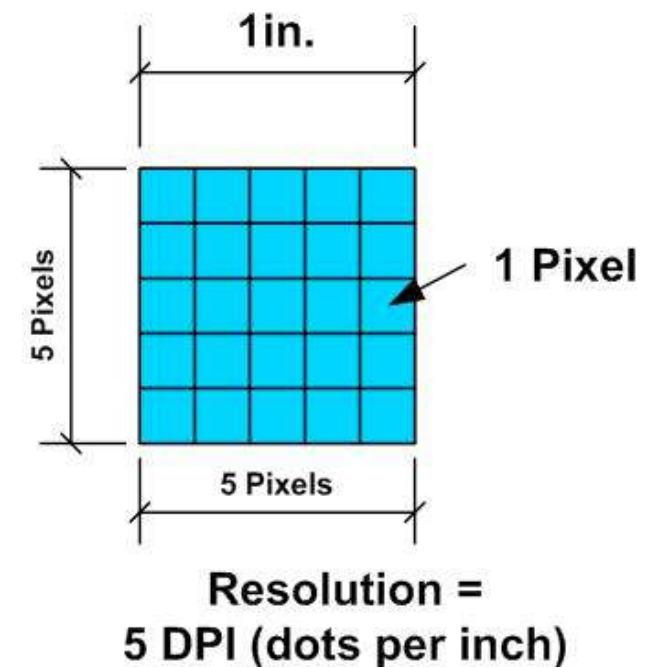
Cathode Ray Tube (CRT)

- 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

electron beam

electron gun

focussing and deflection

phosphor-coated screen
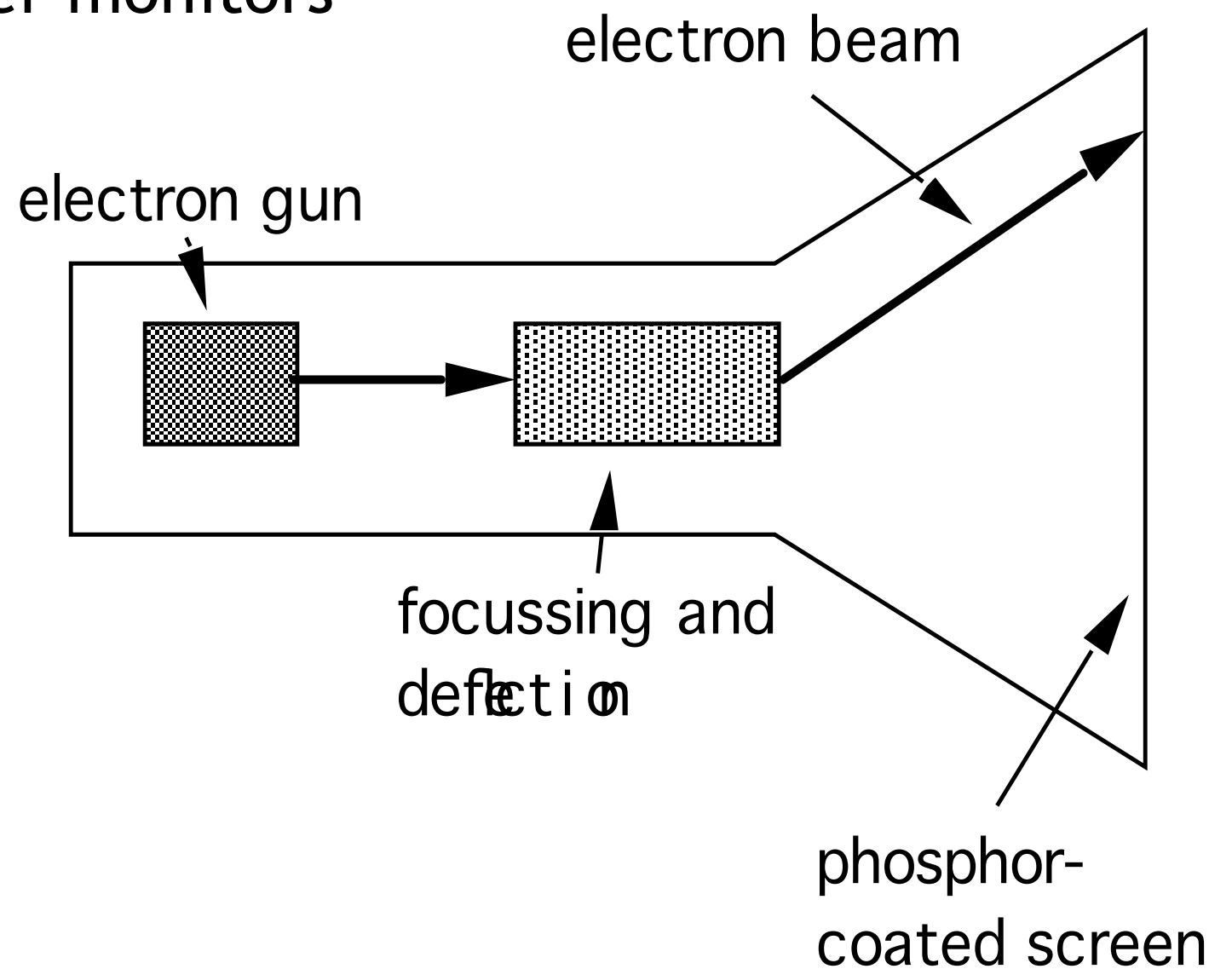
Liquid Crystal Displays (LCD)

- **Smaller, lighter, and ... no radiation problems.**

- **Found on PDAs, portables and notebooks,**
  ... 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 polarized, bottom plate reflecting.
  - Light passes through top plate and crystal, and reflects back to eye.
  - Voltage applied to crystal changes polarization and hence color.
  - N.B. light reflected not emitted => less eye strain

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 screen

- **In all cases … the location matters**

  – Meaning of information or interaction is related to the location, the **context of operation**.

Hermes a situated display

Small displays beside office doors

Office owner reads notes using web interface

Handwritten notes left using stylus

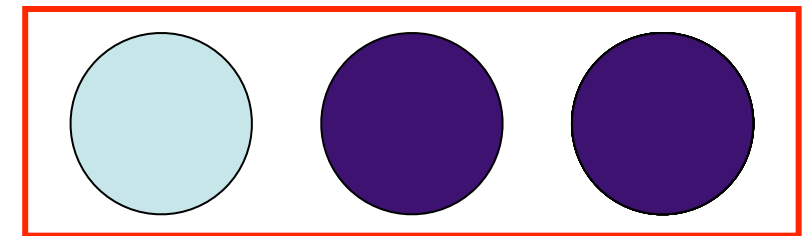# Digital/Interactive Paper

- **What?**
  - Thin flexible sheets
  - Updated electronically
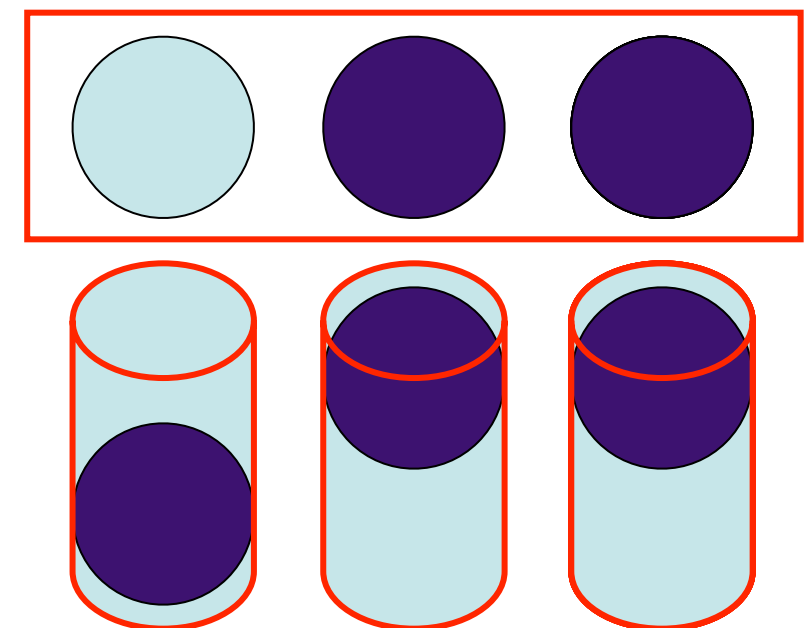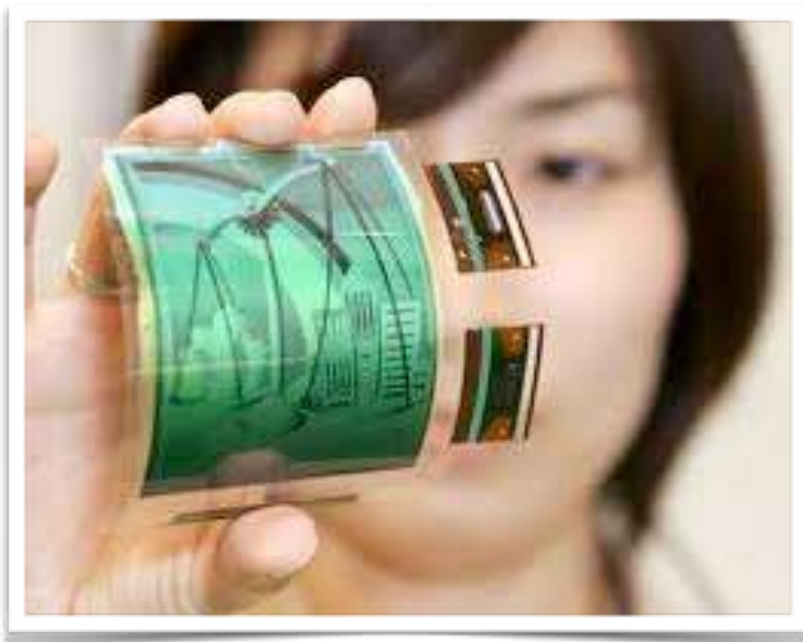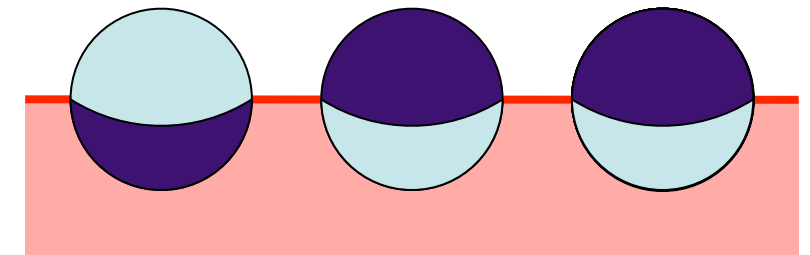 - But retain display

- **How?**
  - Small spheres <u>rotated</u>
  - Or channels with colored 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)

- **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
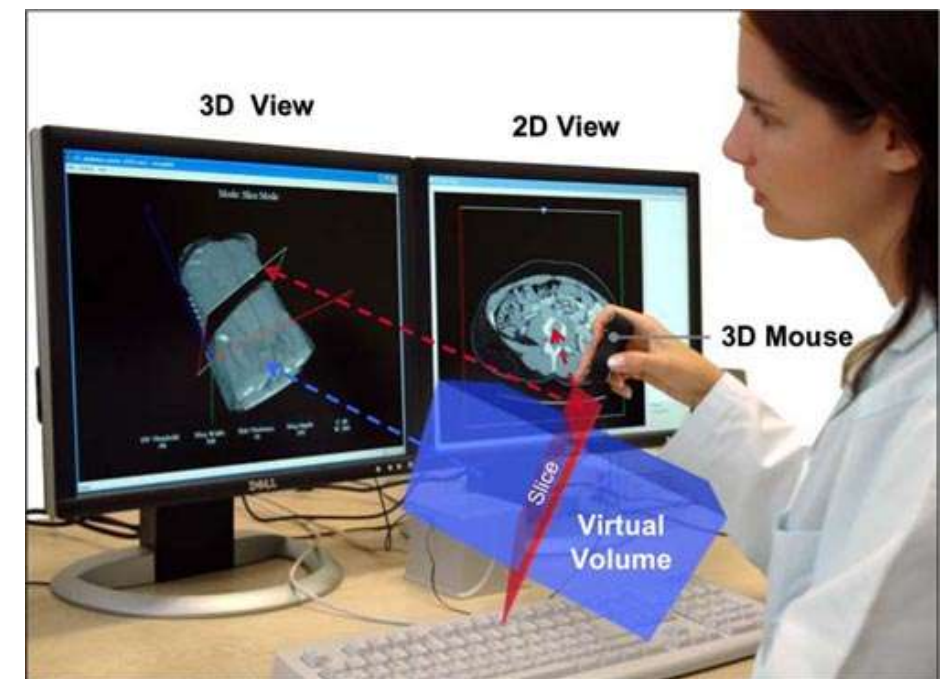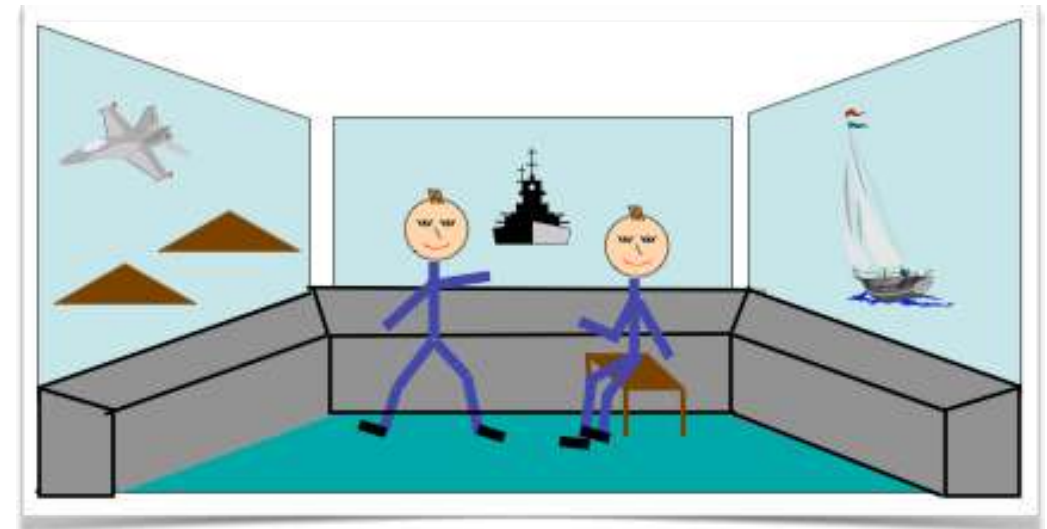
- **Whole body tracking**
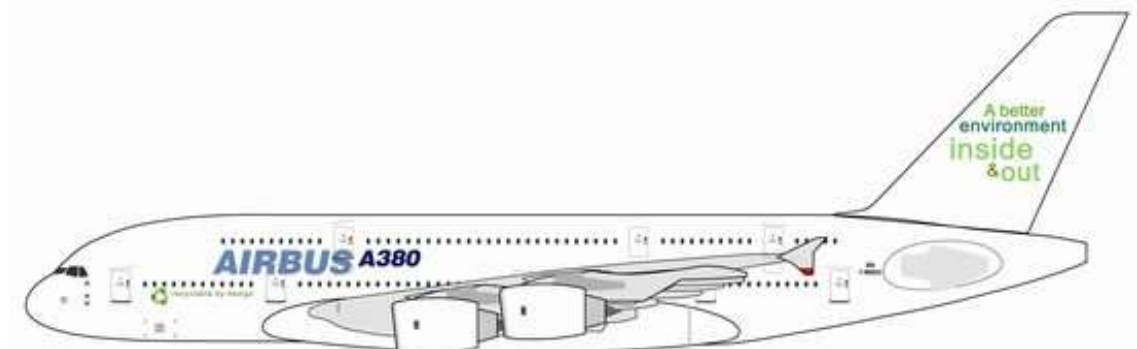 - Accelerometers strapped to limbs or reflective dots and video processing

Simulators and VR caves

- Scenes **projected** on walls
- **Realistic** environment
- **Hydraulic** rams!
- **Real** controls
- Interact with **other** people

e.g. **A380** Virtual Cockpit

Augmented Reality

It is a created environment that mixes **virtual** and **effective** **reality** elements, creating so a mixed environment in real time.

Augmented Reality

It is a created environment that mixes **virtual** and **effective** **reality** elements, creating so a mixed environment in real time.
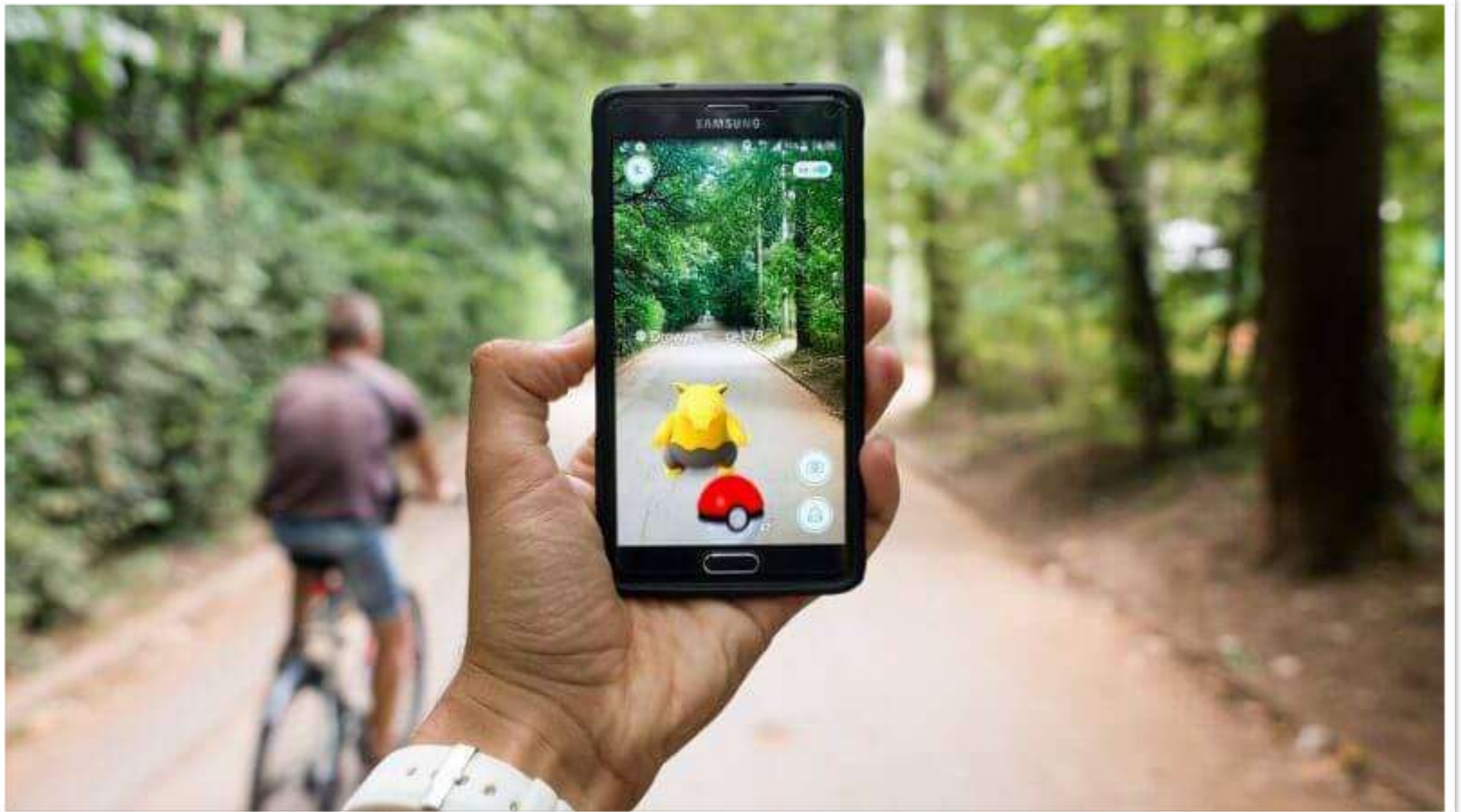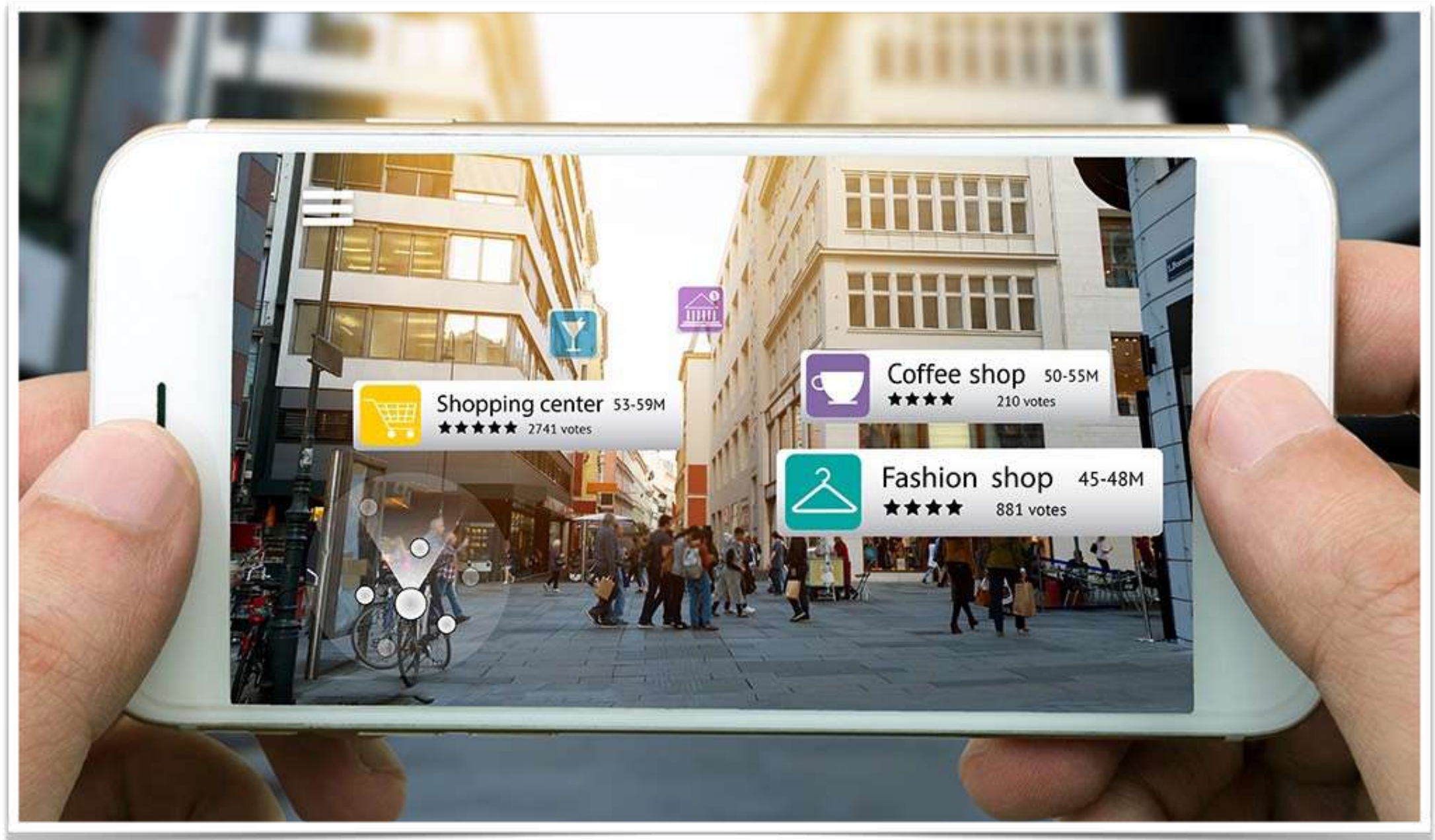
Augmented Reality

It is a created environment that mixes **virtual** and **effective** **reality** elements, creating so a mixed environment in real time.

HUMAN-COMPUTER INTERACTION

THIRD EDITION

DIX
FINLAY
ABOWD
BEALE

Chapter 3

The Interaction

The Interaction
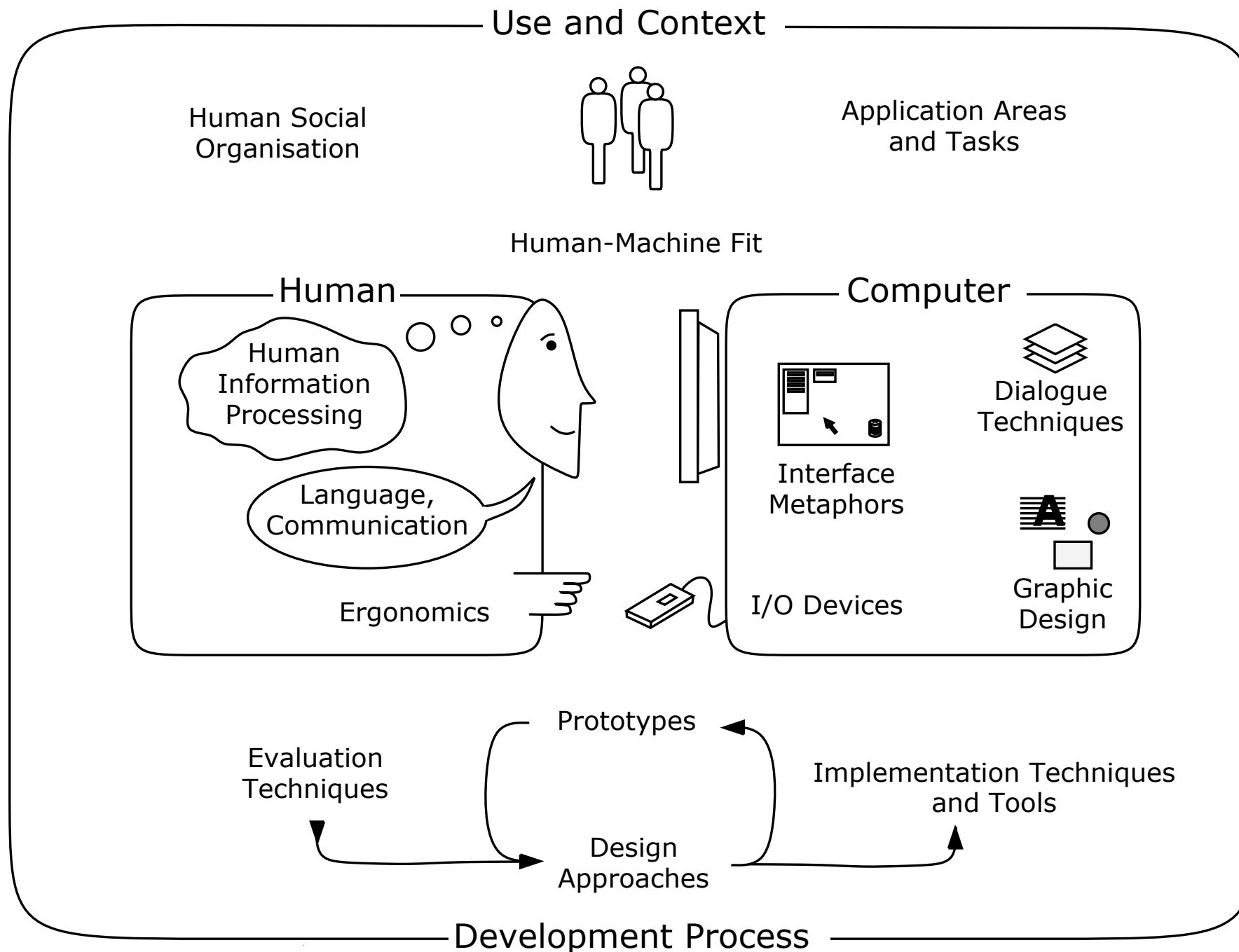
Figure 1.1: The nature of Human-Computer Interaction. Adapted from Figure 1 of the ACM SIGCHI Curricula for Human-Computer Interaction [Hewett et al., 2002]

Communication

User ⟷ **System**

Task language   **Core** language

Some terms of interaction

Domain: The **area** of work under study

              e.g. graphic design

Goal: **What** you want to achieve

              e.g. create a solid red triangle

Task: **How** you go about doing it
ultimately in terms of operations or actions

              e.g. … select fill tool, click over triangle

Donald Norman's Model

- **Seven stages**

  1. User establishes the goal
  2. Formulates intention
  3. Specifies actions at interface
  4. Executes action
  5. Perceives system state
  6. Interprets system state
  7. Evaluates system state with respect to goal

- **Norman's model concentrates on user's view of the interface**

execution/evaluation loop

- user establishes the goal
- formulates intention
- specifies actions at interface
- executes action
- perceives system state
- interprets system state
- evaluates system state with respect to goal

execution/evaluation loop

goal

execution   evaluation

system

- user establishes the goal
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Donald Norman's Model

execution/evaluation loop

goal

execution → system → evaluation

- user establishes the goal
- formulates intention
- specifies actions at interface
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- perceives system state
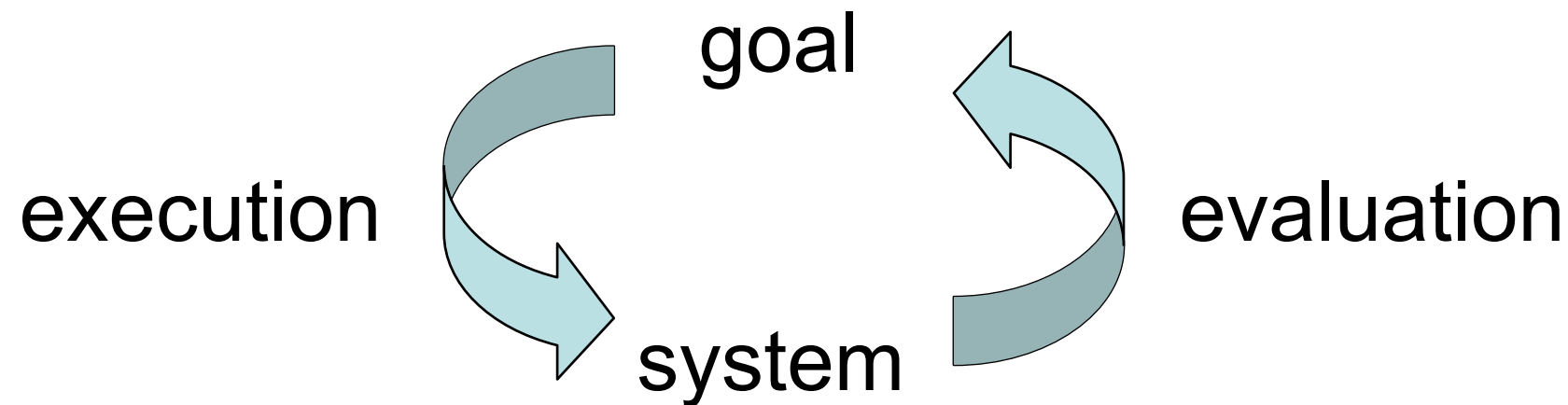- interprets system state
- evaluates system state with respect to goal
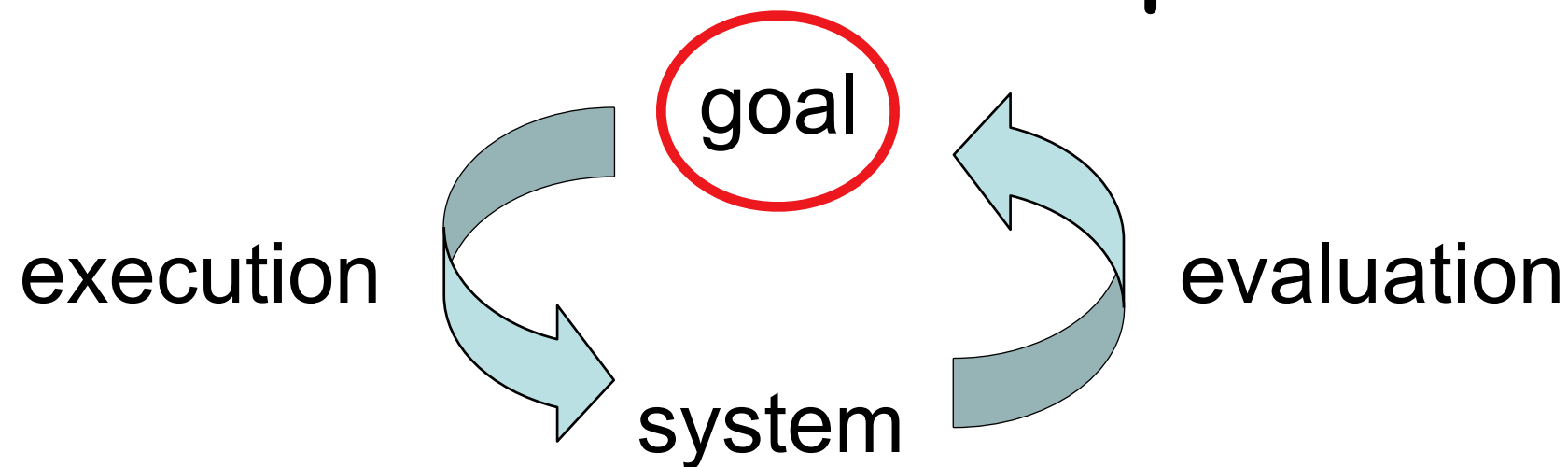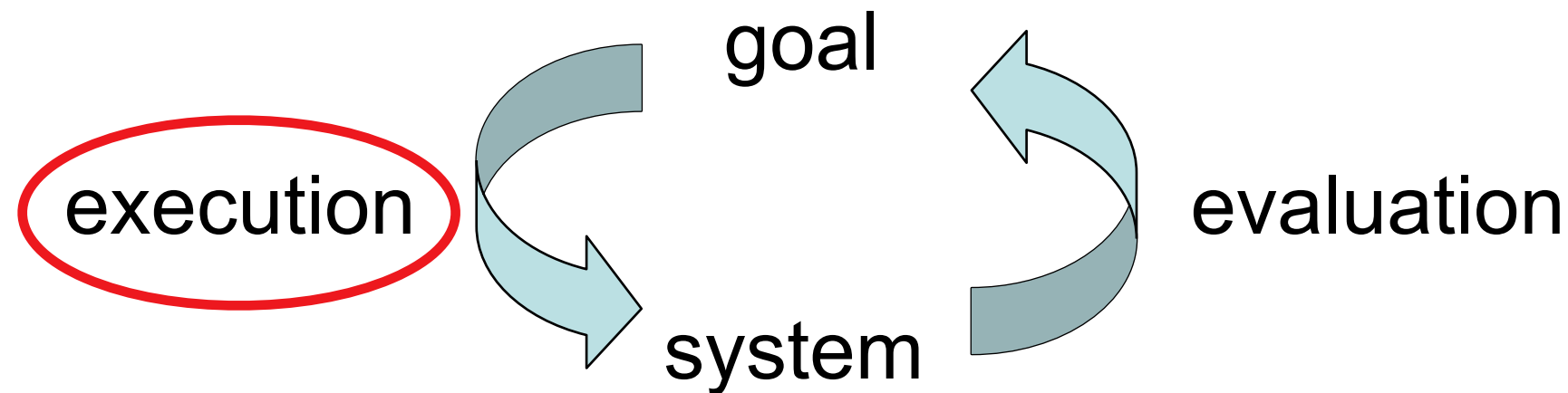
Donald Norman's Model

execution/evaluation loop

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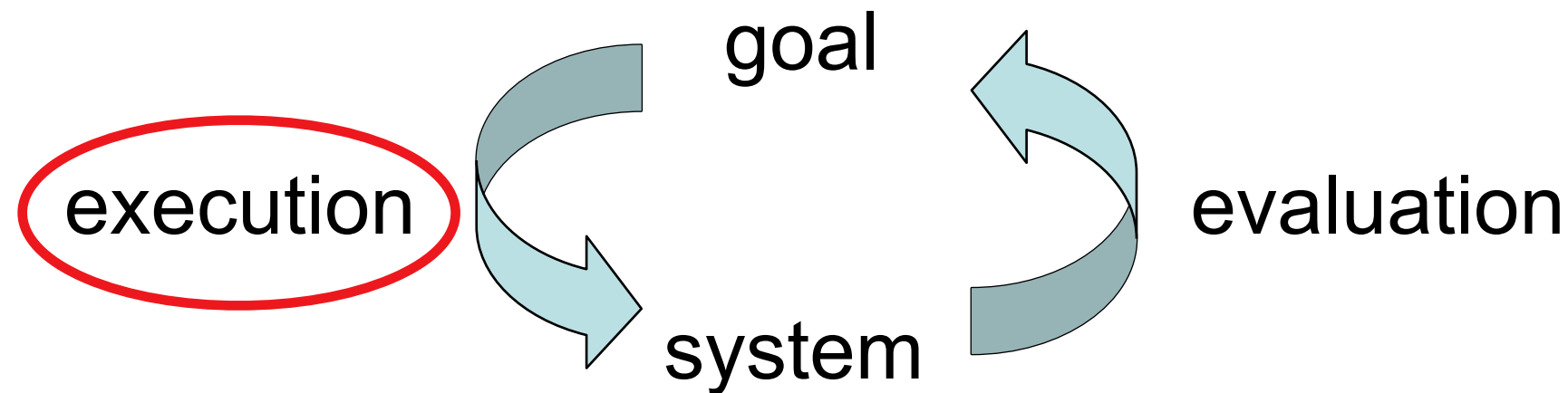
execution/evaluation loop

goal

execution   evaluation

system

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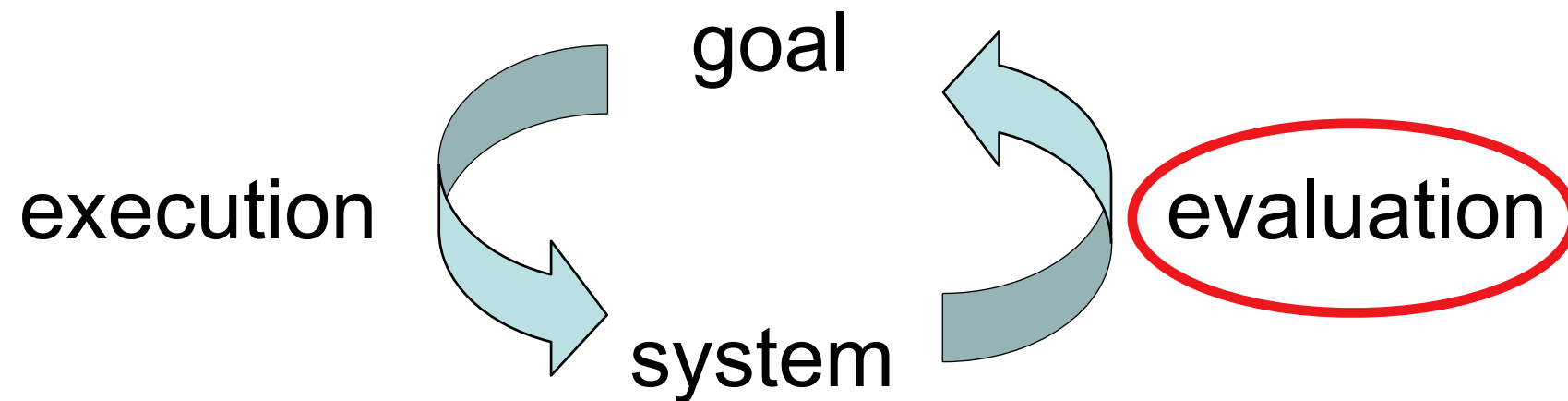*Some systems are harder to use than others*

Why?

Gulf of Execution

user's formulation of actions

≠ actions allowed by the system

Gulf of Evaluation

user's expectation of changed system state

≠ actual presentation of this state

Human error —> Slips and Mistakes

Slip
- 🙂 understand system and goal
- 🙂 correct formulation of action
- 🙁 incorrect action

Mistake
- 🙁 may not even have right goal!

Fixing things?
Slip: better interface design
Mistake: better understanding of system

Abowd and Beale framework

Extension of Norman's Model their interaction framework has **4 parts**

- **U**ser
- **I**nput
- **S**ystem
- **O**utput

O
output

presentation

observation

S

U

core

task

performance

I
input

articulation
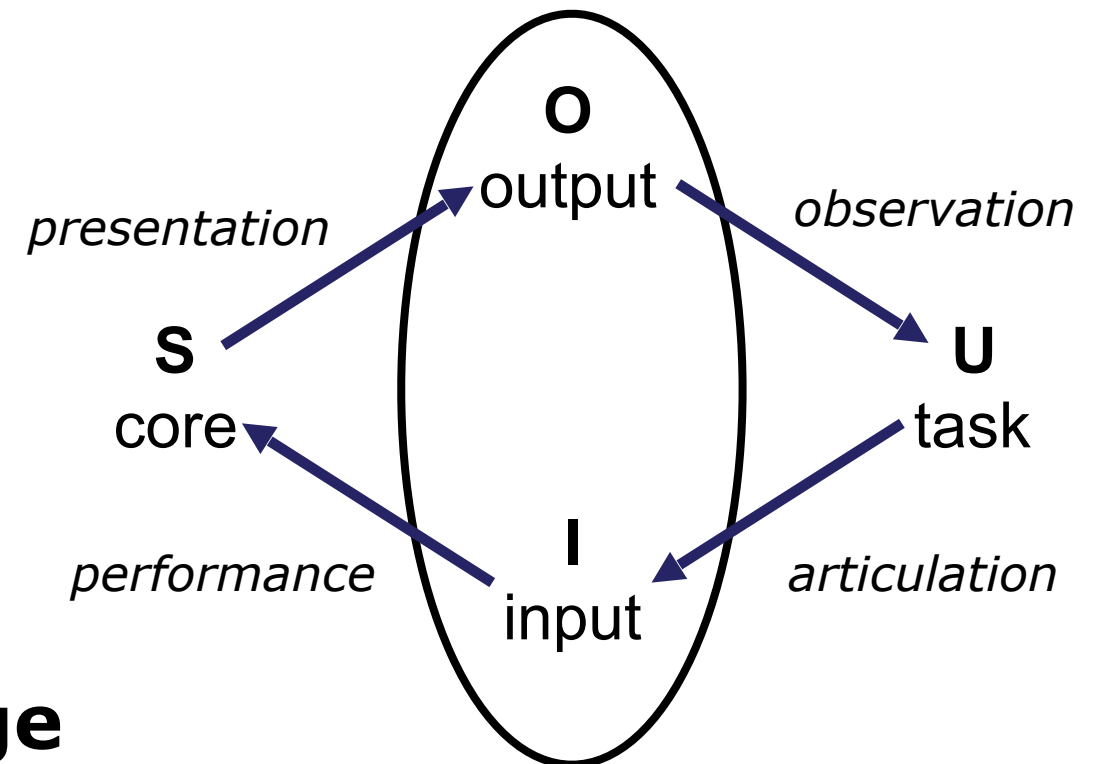
Each has its own unique language

Interaction ⇒ Translation between languages

Problems in interaction == Problems in translation

User intentions
 → translated into actions at the interface
  → translated into alterations of system state
   → reflected in the output display
    → interpreted by the user

General framework for understanding interaction
 – not restricted to electronic computer systems
 – identifies all major components involved in interaction
 – allows comparative assessment of systems
 – an abstraction

The Ergonomics of Interaction

- Study of the physical characteristics of interaction (ex: how controls are designed)

- Also known as human factors – but this can also be used to mean much of HCI!

- Ergonomics <u>good at defining standards</u> and <u>guidelines</u> for constraining the way we design certain aspects of systems

The Ergonomics of Interaction

Examples:

- **Arrangement of controls and displays**

  e.g.   controls grouped according to function or frequency of use, or sequentially

- **Surrounding environment**

  e.g.   seating arrangements adaptable to cope with all sizes of user

- **Health issues**

  e.g.   physical position, environmental conditions (temperature, humidity), lighting, noise,

- **Use of color**

  e.g.   use of red for warning, green for okay, awareness of color-blindness and culture etc.

The Ergonomics of Interaction

- **Arrangement of controls and displays**

  e.g. controls grouped according to function or frequency of use, or sequentially
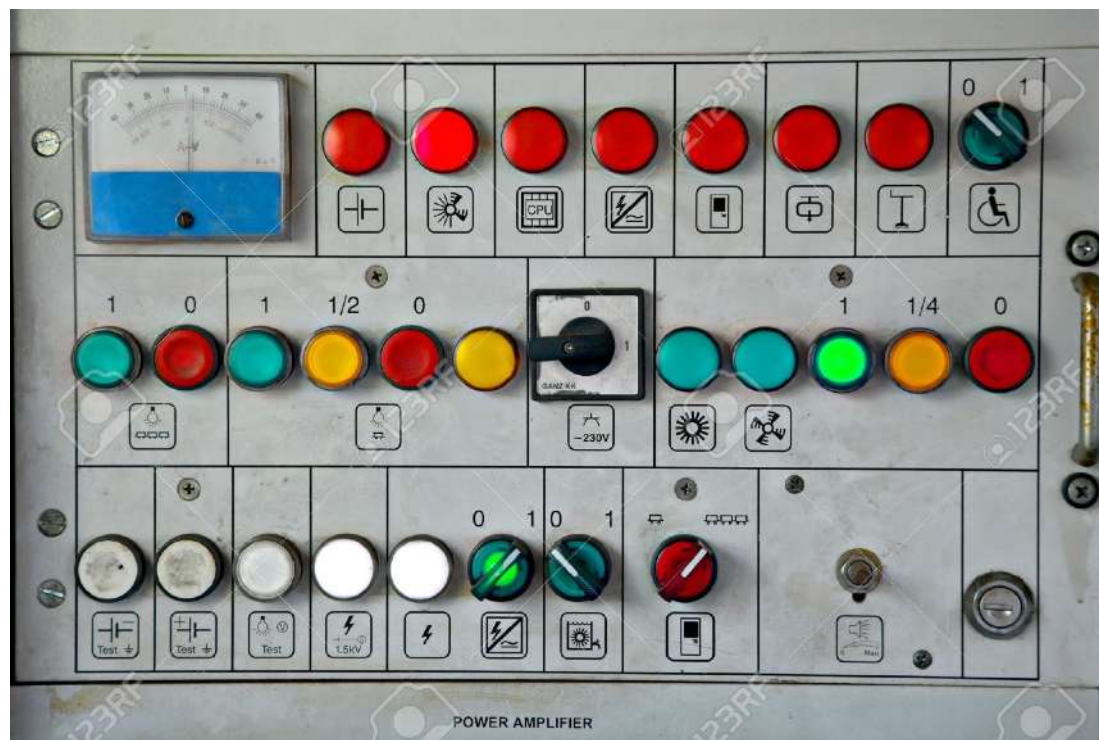
Office interface vs. industrial interface?

Context matters!

	office	industrial
type of data	textual	numeric
rate of change	slow	fast
environment	clean	dirty

Glass interfaces

- **Industrial interface:**
  - traditional … dials and knobs
  - now … screens and keypads

- **Glass interface**
  + cheaper, more flexible, multiple representations, precise values
  - not physically located, loss of context, complex interfaces

- **May need both**

Vessel B Temp

| 0 | 100 | 200 |

113
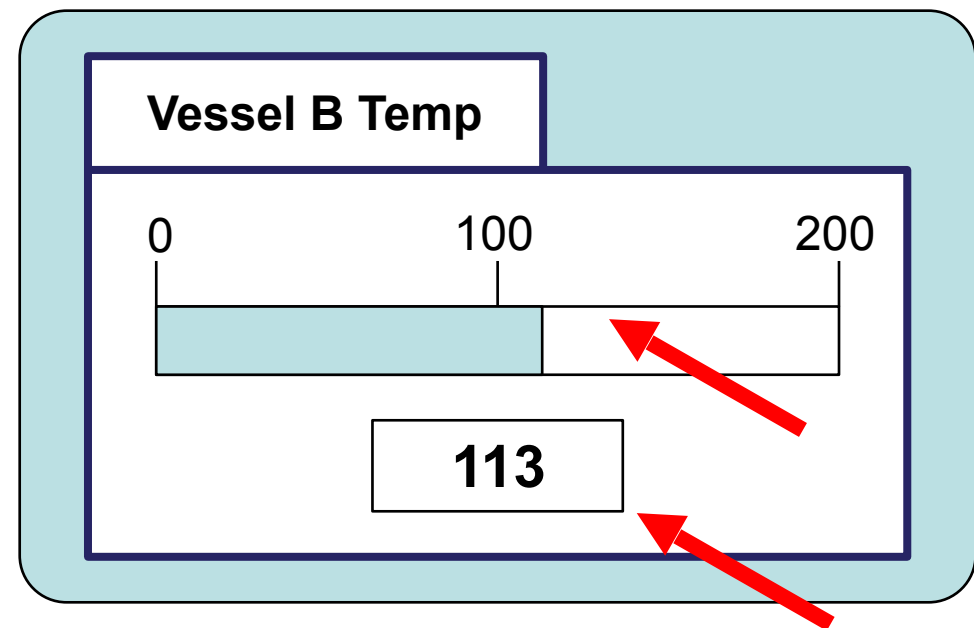
Multiple representations of same information

Direct & Indirect Manipulation

- **Office** – direct manipulation
  - User interacts
    with an artificial world

- **Industrial** – indirect manipulation
  - User interacts
    with the real world, but
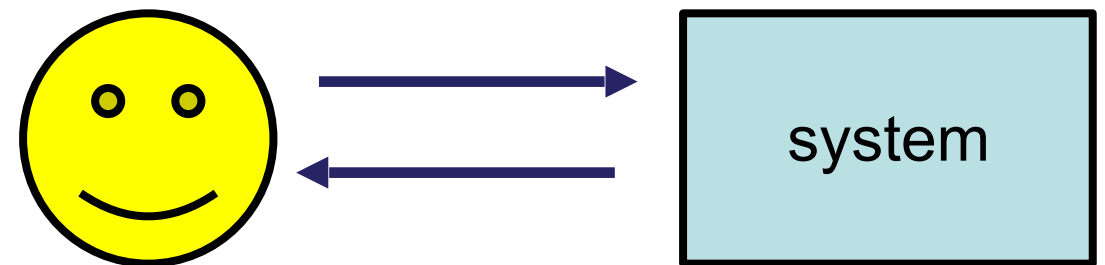   *through* an interface

- **Issues** …
  - Feedback
  - Delays

system

interface   plant

immediate
feedback

instruments
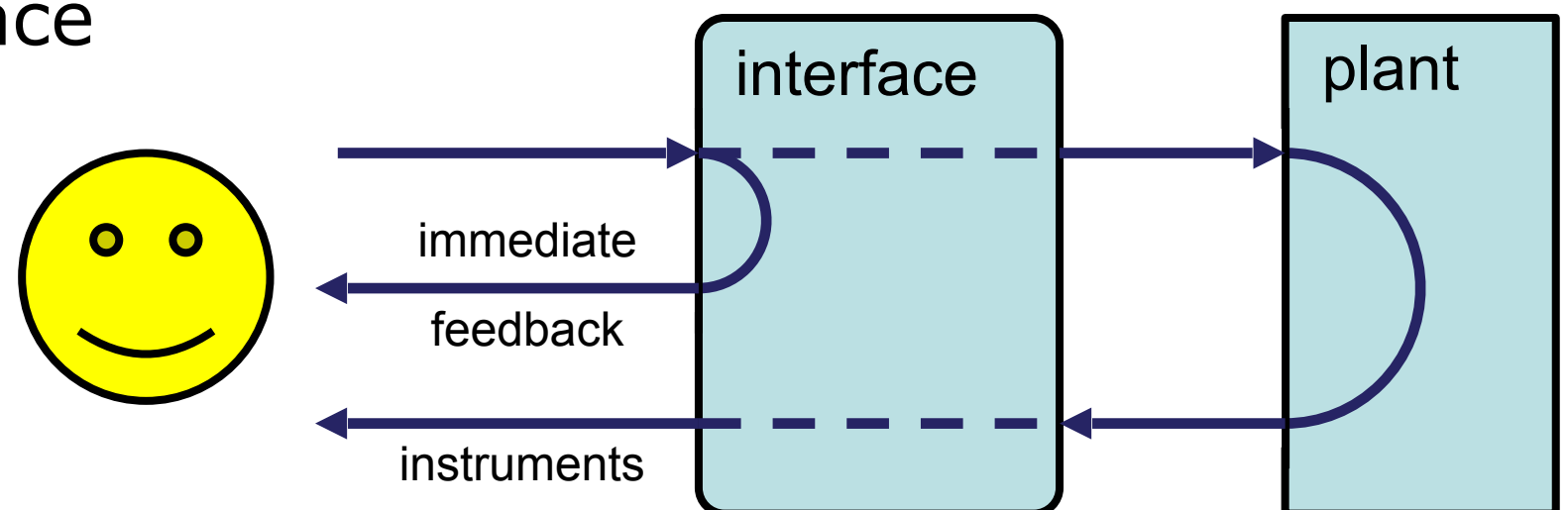
Chapter 5

Interaction Design Basics

Interaction Design Basics

- **Design:**
  - What is it? Interventions, goals, constraints;
- **The design process**
  - What happens when
- **Users**
  - Who they are, what they are like …
- **Scenarios**
  - Rich stories of design
- **Navigation**
  - Finding your way around a system
- **Iteration and prototypes**
  - Never get it right first time!

Design interactions not just interfaces

not just the immediate interaction

e.g. stapler in office – technology changes interaction style

- Manual: write, print, staple, write, print, staple, …
- Electric: write, print, write, print, …, staple

Designing interventions not just artifacts

not just the system, but also …

- documentation, manuals, tutorials
- what we say and do as well as what we make

What is design?

What is design?

Achieving goals within constraints

- **Goals - purpose**

  – **who** is it for, **why** do they want it

- **Constraints**

  – materials, platforms

- **Trade-offs**

  – Good vs. optimum!

Understand your materials!

Understand your materials

- **Understand computers**

  – limitations, capacities, tools, platforms

- **Understand people**

  – psychological, social aspects

  – human error

- **and their interaction ...**

To err is human

- **Accident reports ..**
  - air-crash, industrial accident, hospital mistake
  - enquiry … **blames** … '**human error**'
- **but …**
  - concrete lintel breaks because too much weight
  - blame 'lintel error' ?
    … no – design error
    we know how concrete behaves under stress
- **human 'error' is normal!**
  - we know how users behave under <u>stress</u>
  - so design for it!
- **treat the user at least as well as physical materials!**

the user

The Process of Design

scenarios
task analysis

what is wanted

guidelines
principles

interviews
ethnography

analysis

precise
specification

what is there
vs.
what is wanted

design

dialogue
notations

**implement
and deploy**

evaluation
heuristics

prototype

architectures
documentation
help
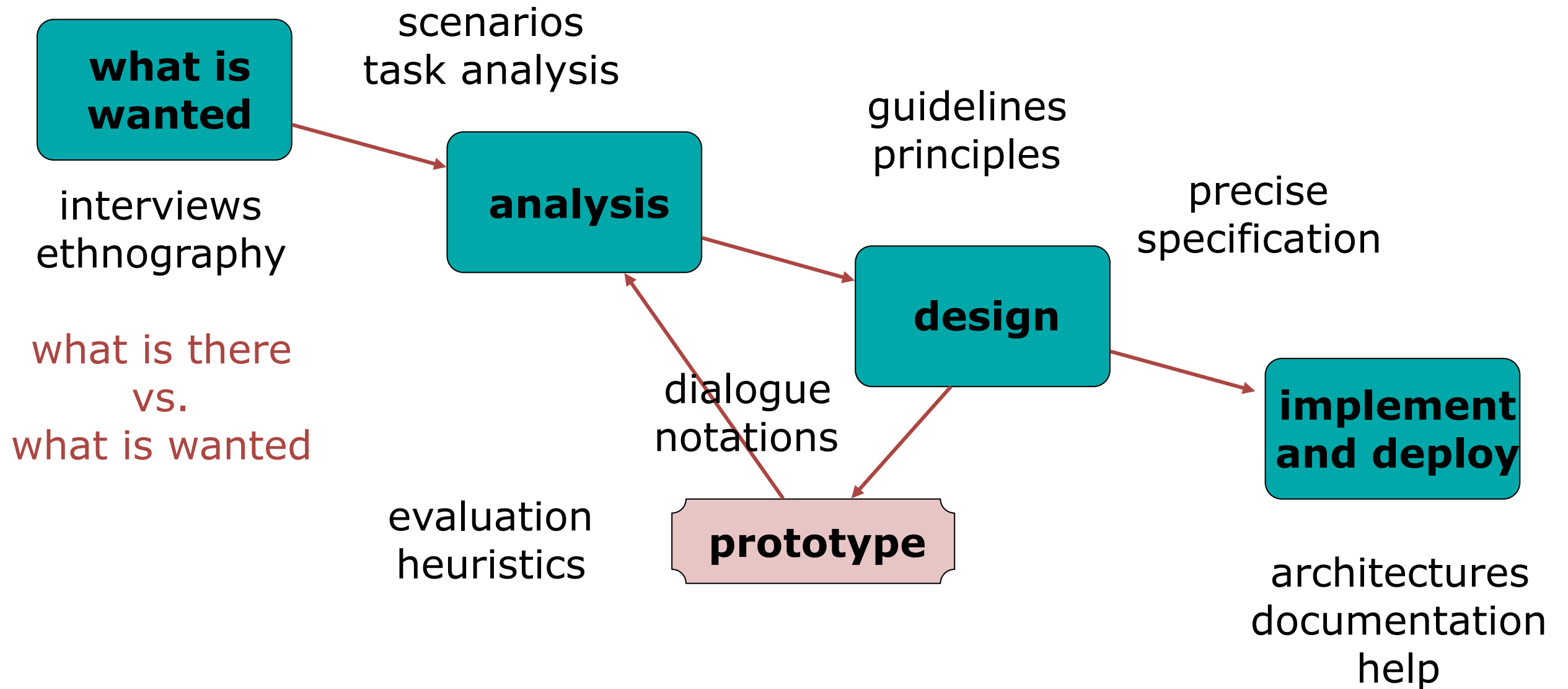
Steps …

- **Requirements**

  – What is there (user context) and what is wanted …

- **Analysis**

  – Ordering and understanding

- **Design**

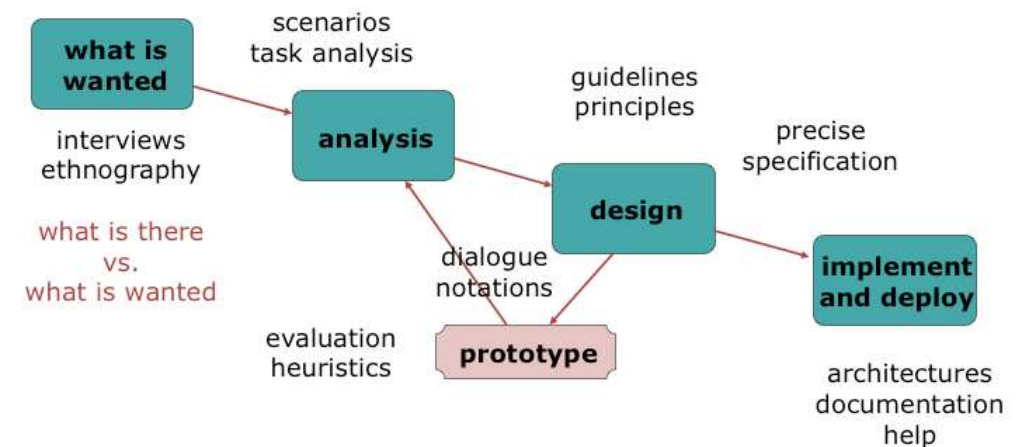 – What to do and how to decide; guidelines; heuristics <= cognitive models.

- **Iteration and prototyping**

  – Getting it right … and finding what is really needed!

- **Implementation and deployment**

  – Making it and getting it out there.

… but how can I do it all ! !

- **Limited time** $\Rightarrow$ **design trade-off**

- **Usability?**
  - Finding problems and fixing them?   ✗
        this is easy!
  - Deciding what to fix?   ✓

- **Attention**: *"A perfect system is badly designed"*

  - too good $\Rightarrow$ too much effort in design

A Commandment!

- **Who are they?**
  - more than one
  - artifacts used.

- **Probably <u>not</u> like you!**
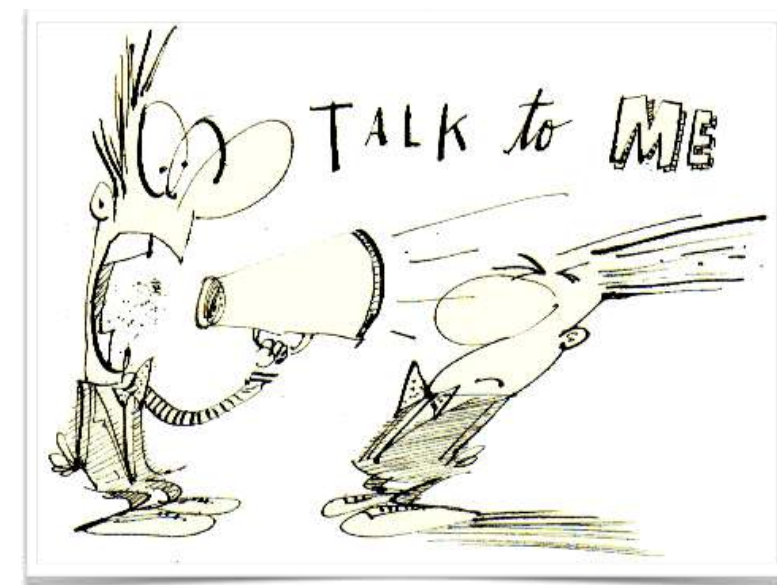 - old ≠ new. (e.g. triangle exercise)

- **Watch them**
  - what they doing it? (introspection difficulty!)

- **Talk to them**
  - why they do!

- **Use your imagination**
  - *participation design*.

TALK to ME

Cultural Probes

- **Direct observation**
  - sometimes hard
    - in the home
    - psychiatric patients, ...

- **Probe packs**
  - items to prompt responses
    - e.g. glass to listen at wall, camera, postcard
  - given to people to open in their own environment
    they record what is meaningful *to them*

- **Used to ...**
  - inform interviews, prompt ideas, en-culture designers

- **Description of a user type**

  – not necessarily a real person

- **Use as surrogate user**

  – example: what would Betty think …

- **Details matter**

  – makes her 'real'

Persona - an example:

Betty is 37 years old, She has been Warehouse Manager for five years and worked for Simpkins Brothers Engineering for twelve years. She didn't go to university, but has studied in her evenings for a business diploma. She has two children aged 15 and 7 and does not like to work late. She did part of an introductory in-house computer course some years ago, but it was interrupted when she was promoted and could no longer afford to take the time. Her vision is perfect, but her right-hand movement is slightly restricted following an industrial accident 3 years ago. She is enthusiastic about her work and is happy to delegate responsibility and take suggestions from her staff. However, she does feel threatened by the introduction of yet another new computer system (the third in her time at SBE).

Persona - an example:

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