Human Interface by multimedia

Linguistic information

Non-linguistic information
Image, table, video, gender, age, physique, behavior, eye movement, voice characteristics, expression, emotion, etc.

These various information are indispensable to be precisely transmitted without distortion and loss, in other words, ‘transmission of presence’ is important in which we feel as if we were there.

Future communication : *Multimedia or multi-modal interface*

Superb interface: Various media are efficiently used and well-balanced in the whole system

Human - computer communication

Present

Human → Computer information transmission

Keyboard, tablet, mouse etc.

Computer → Human information transmission

Display, printer etc.

Future

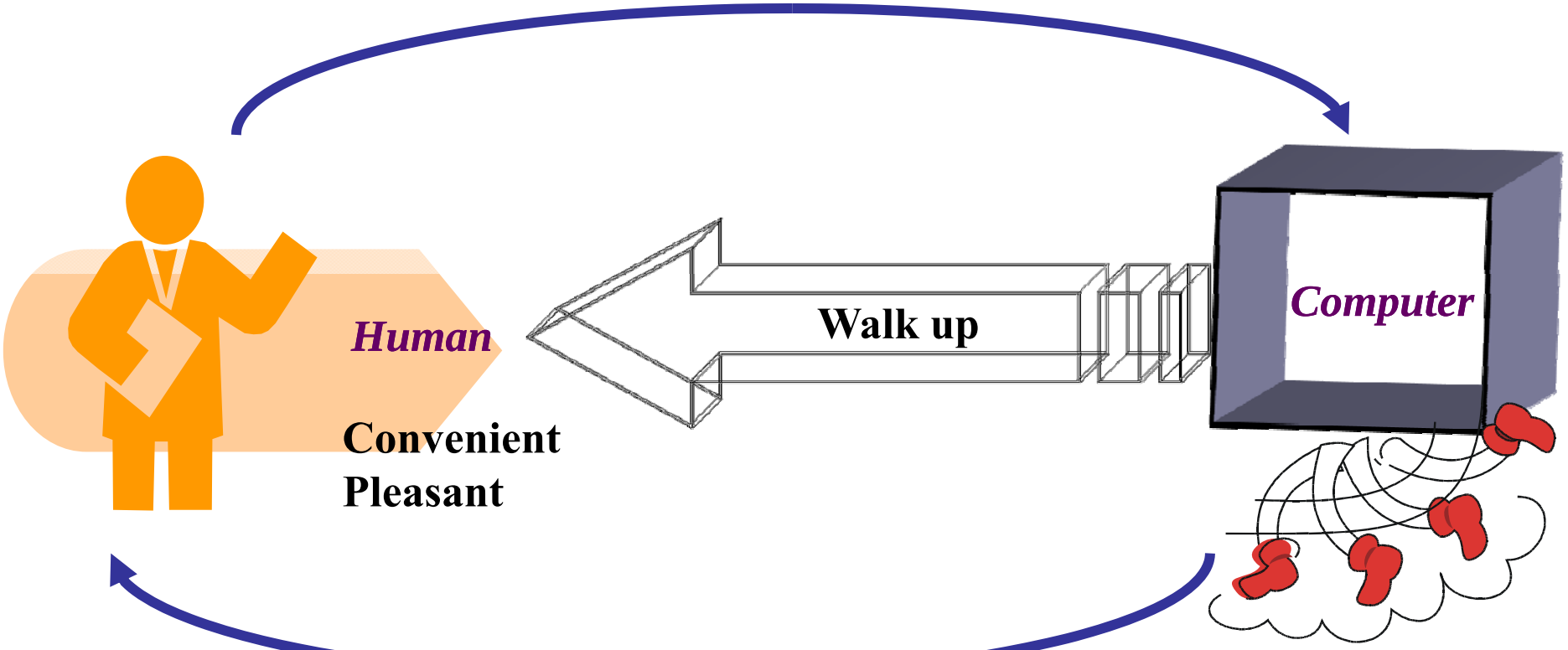
- *Understanding and production of speech and image information*
- *Interface accepting errors*
- *Interface which always offers help when users are confused*
- *Customized interface which can automatically learn and predict users knowledge and thinking process, and automatically correct errors*
- *Interface which explains global information by illustrations and figures, and details by linguistic information*

“ *Sensitive Interface* ”

Human-centered interface

Recognition/understanding

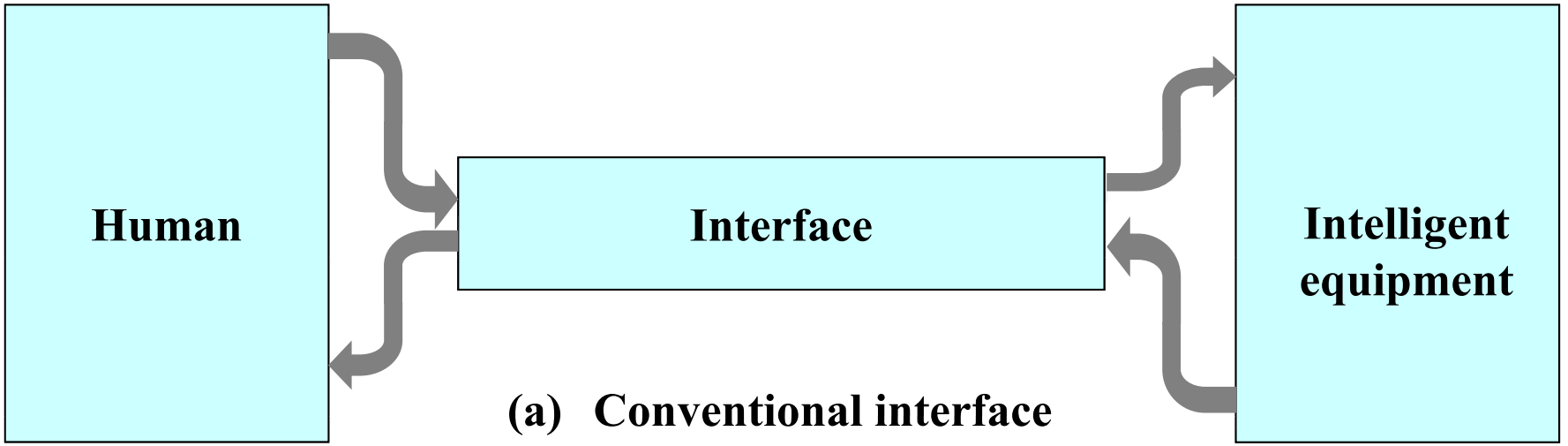
Spoken language, image, gesture



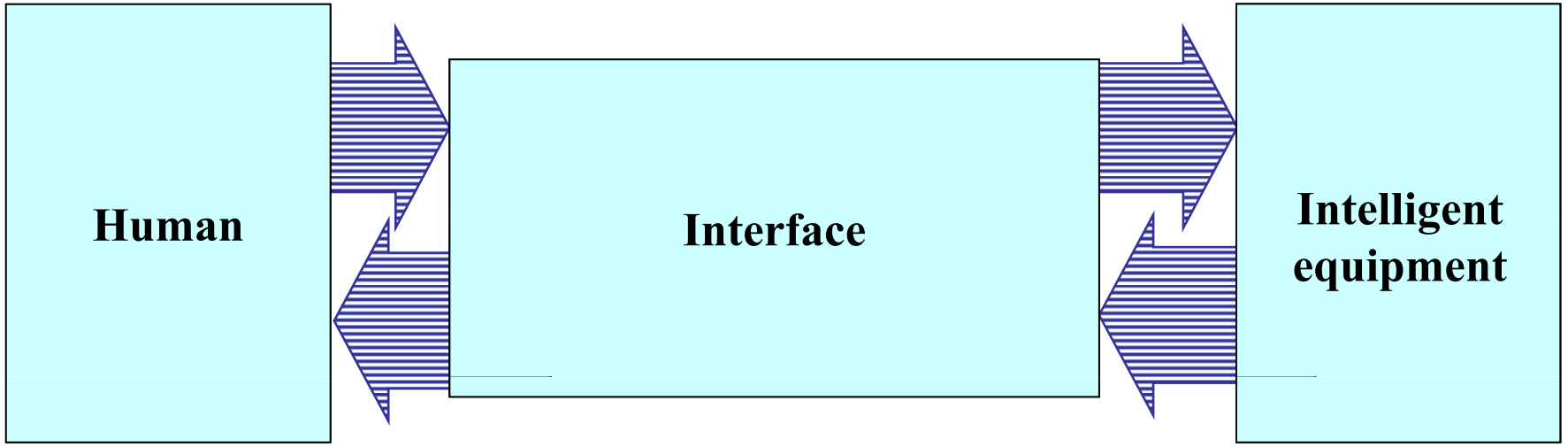
Production/synthesis

Image, sentence, speech, CG

Conventional interface and multimodal interface

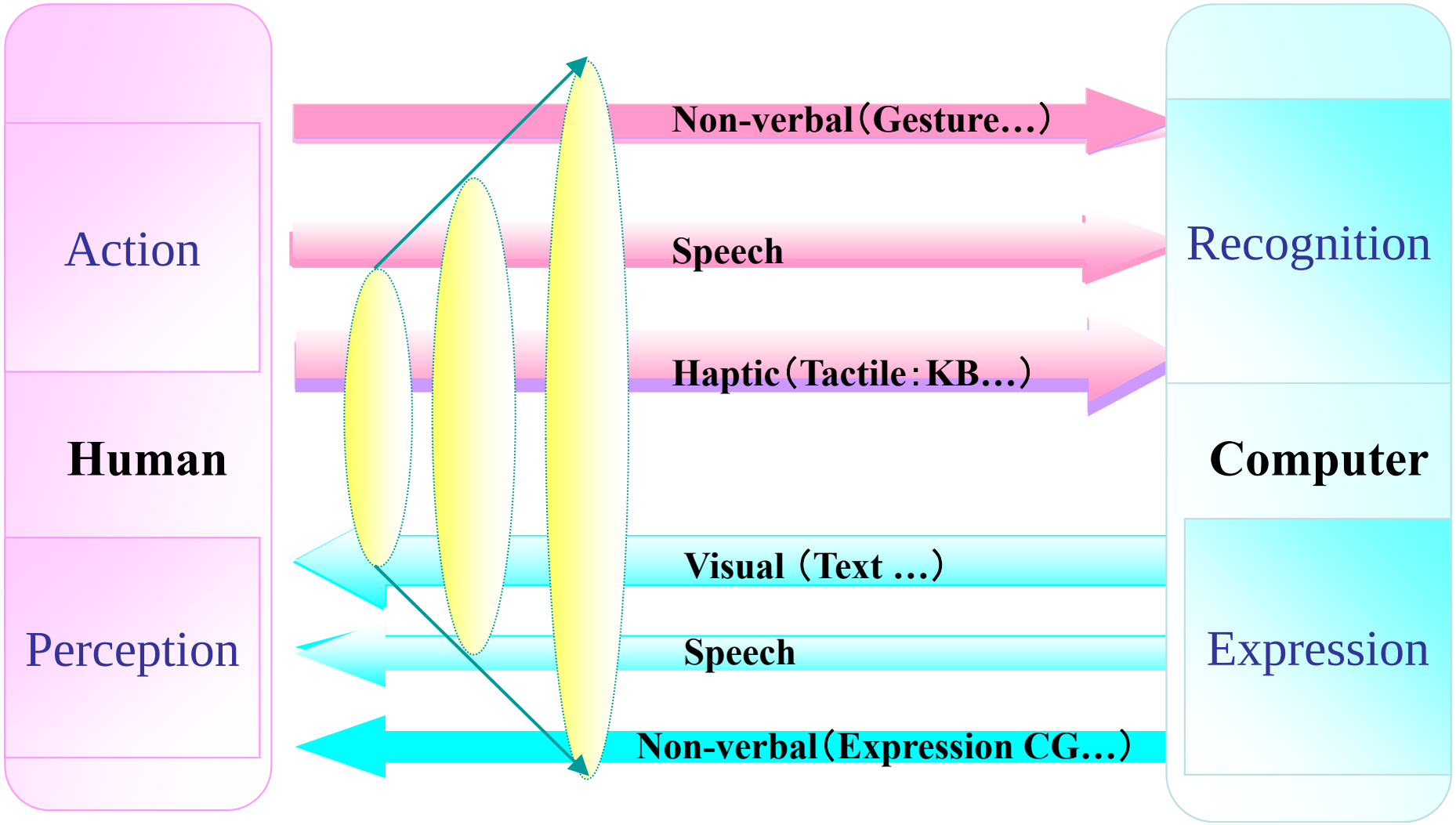


(a) Conventional interface



(b) Multimodal interface

Variation of modalities



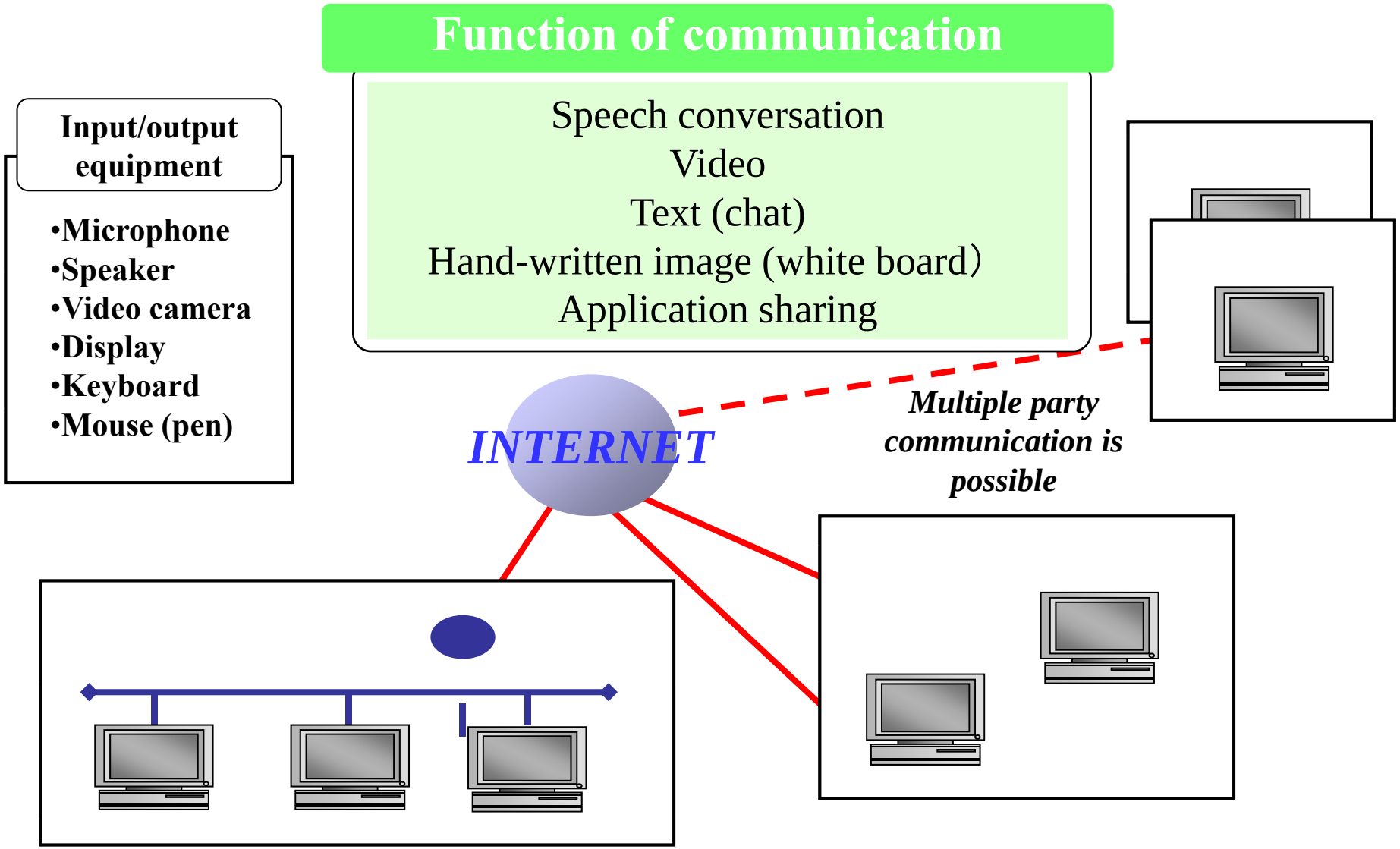
Non-verbal information for communication

Group	Examples	Functions
Peripheral language	Prosodic information, voice quality Pitch structure（pitch, loudness） Time structure（speed, pause） Amplitude structure（loudness） Non-verbal speech Ear-con	Transmission of emotional information Regulator Acceptance, agreement, doubt, surprise, reject Continuation of speech Oralization
Physical activity	Facial expression Gaze, blink, pupil Nodding Body gesture/hand movement Lips Posture	Emblem, illustration, emotion, regulator, adaptation ⇩ HI Sign, instruction, illustration, operation, expression of emotion, adjustment, admiration
Place	Personal distance, space, touch Personal relation Various relation Others（physical characteristics, physiological action/phenomenon, clothes, ornament, make-up, etc.）	Formation of relationship

Various types of input/output equipment

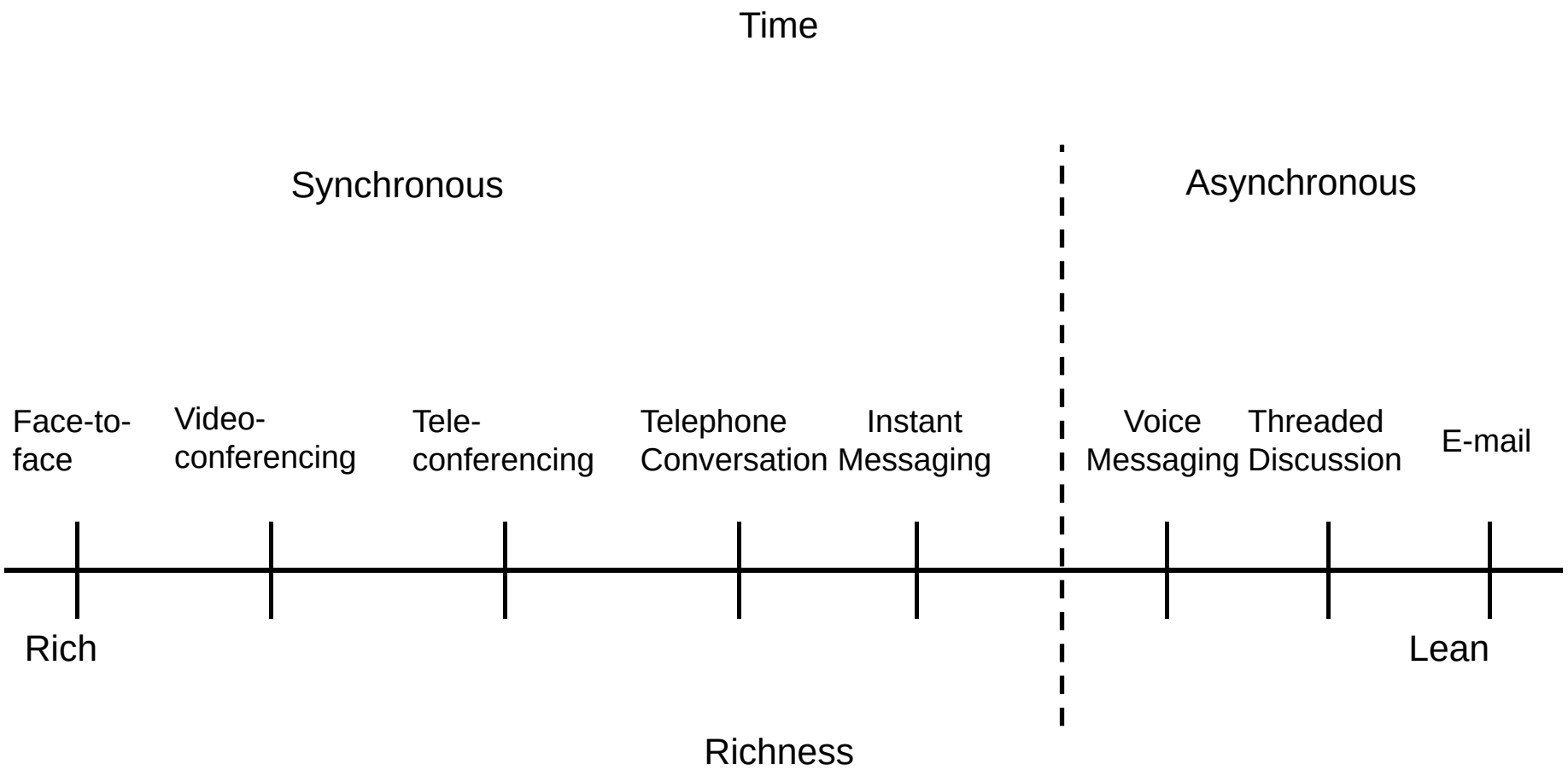
Input/output equipment	Function
Keyboard	Input of written language
Mouse	Input of coordinates（direction of movement and distance）
Tablet	Input of coordinates
Microphone	Speech input
Image scanner	Two-dimensional input of picture/printed materials
Video camera	Visible scenery input
Display（CRT)	TV image/computer output display
Flat display	TV image/computer output display
Plasma panel	
Liquid crystal panel	
Liquid crystal projector	Projection to a wide screen
Printer	Output to papers
DVD	Recording into disks

Image of multimedia communication

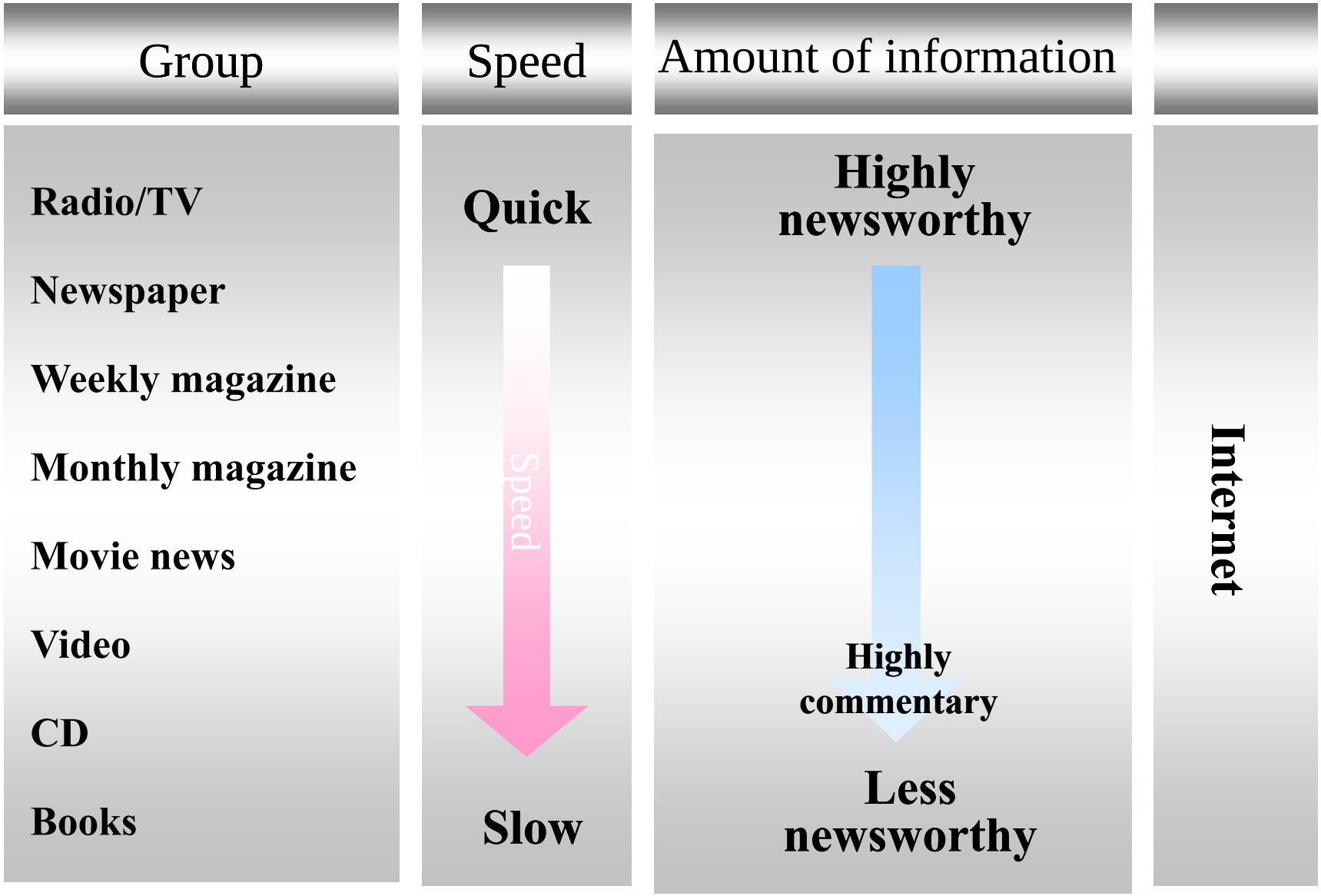


Communication function can be selected according to needs and available input/output equipment.

Information Richness Theory.



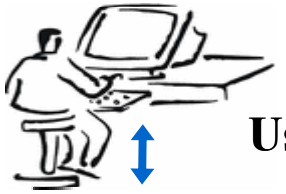
Features of mass-media



Amount of information and transmission speed of various media

Variety of media	Quantity of information	Transmission rate (bit/s)	
		No compression	Compressed
Newspaper	0.32M bit／page (20,000 characters)		
Telephone	230Mbit／H	64K	16K (4)
Music（CD）	4.3Gbit／H	1.4M	256K (5.5)
Video （VHS quality）	109Gbit／H	30M	1.5M (20)
Normal TV （Receiving quality）	360Gbit／H	100M	4M (25)
High definition TV （Studio quality）	4320Gbit／H	1.2G	30M (40)

Structure of natural language interaction



User

Interaction by natural language

Interaction control part

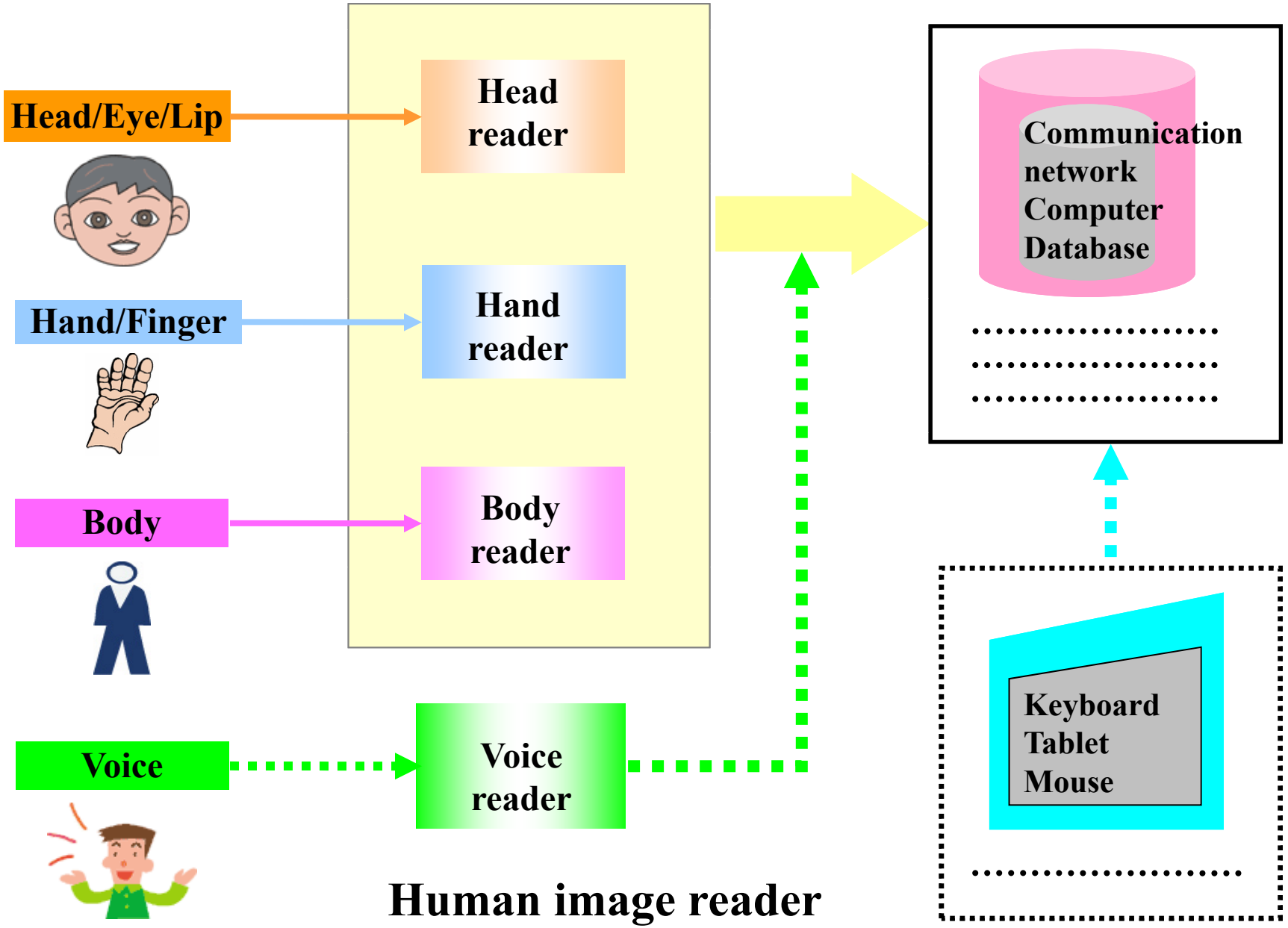
Natural language recognition part

Natural language dictionary

Knowledge base

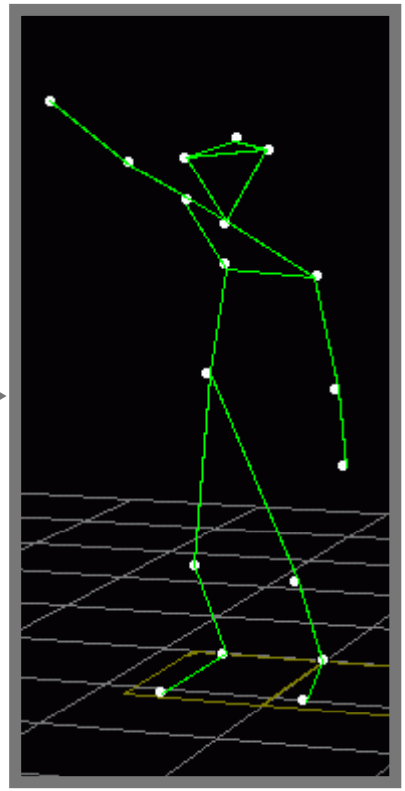
Response production part

Targeted computer system

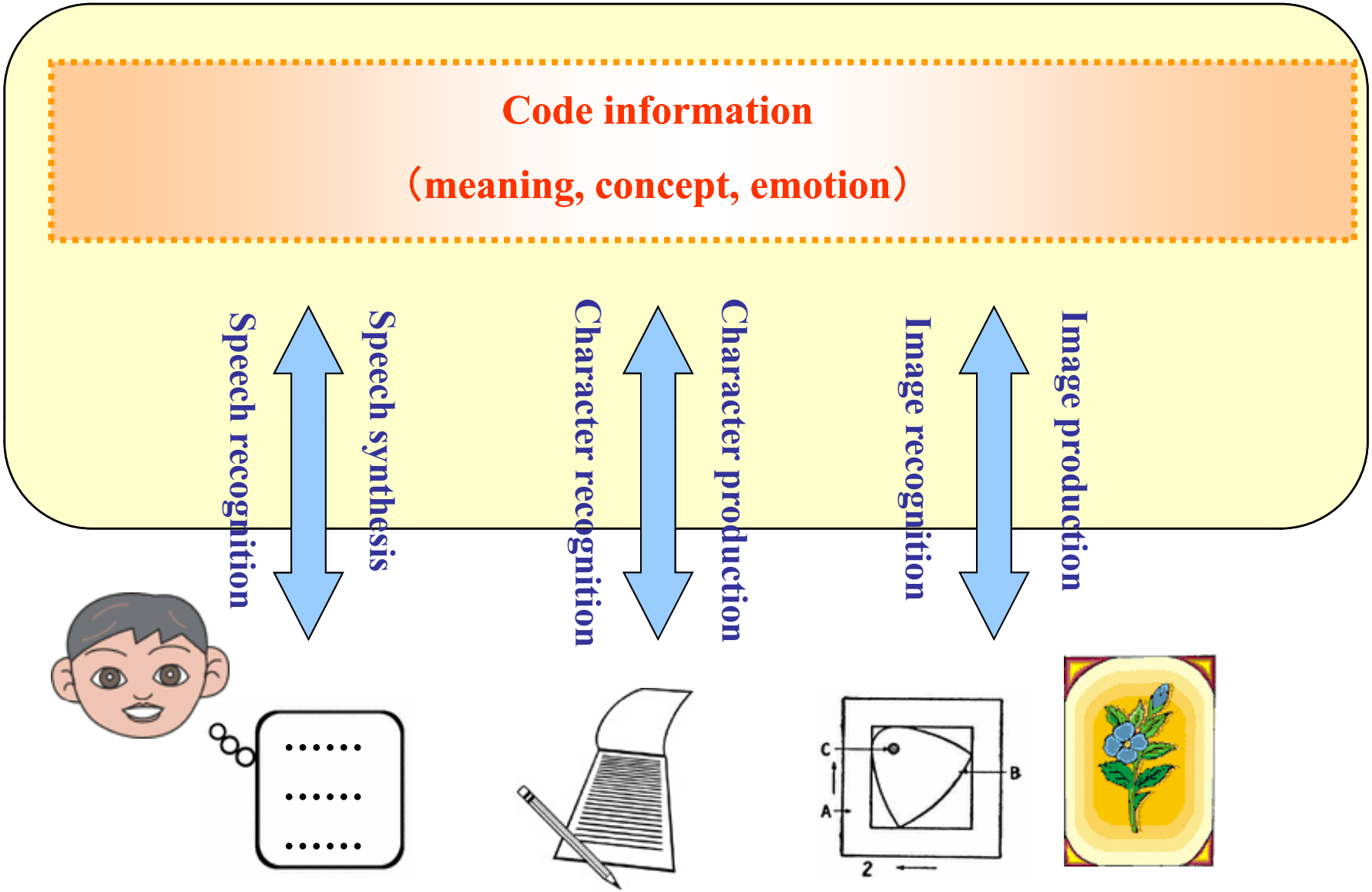

Head/Eye/Lip
Hand/Finger
Body
Voice
Head reader
Hand reader
Body reader
Voice reader
Communication network Computer Database
Keyboard Tablet Mouse
Human image reader

3D-position measurement equipment

Reproduction of actions by motion capture

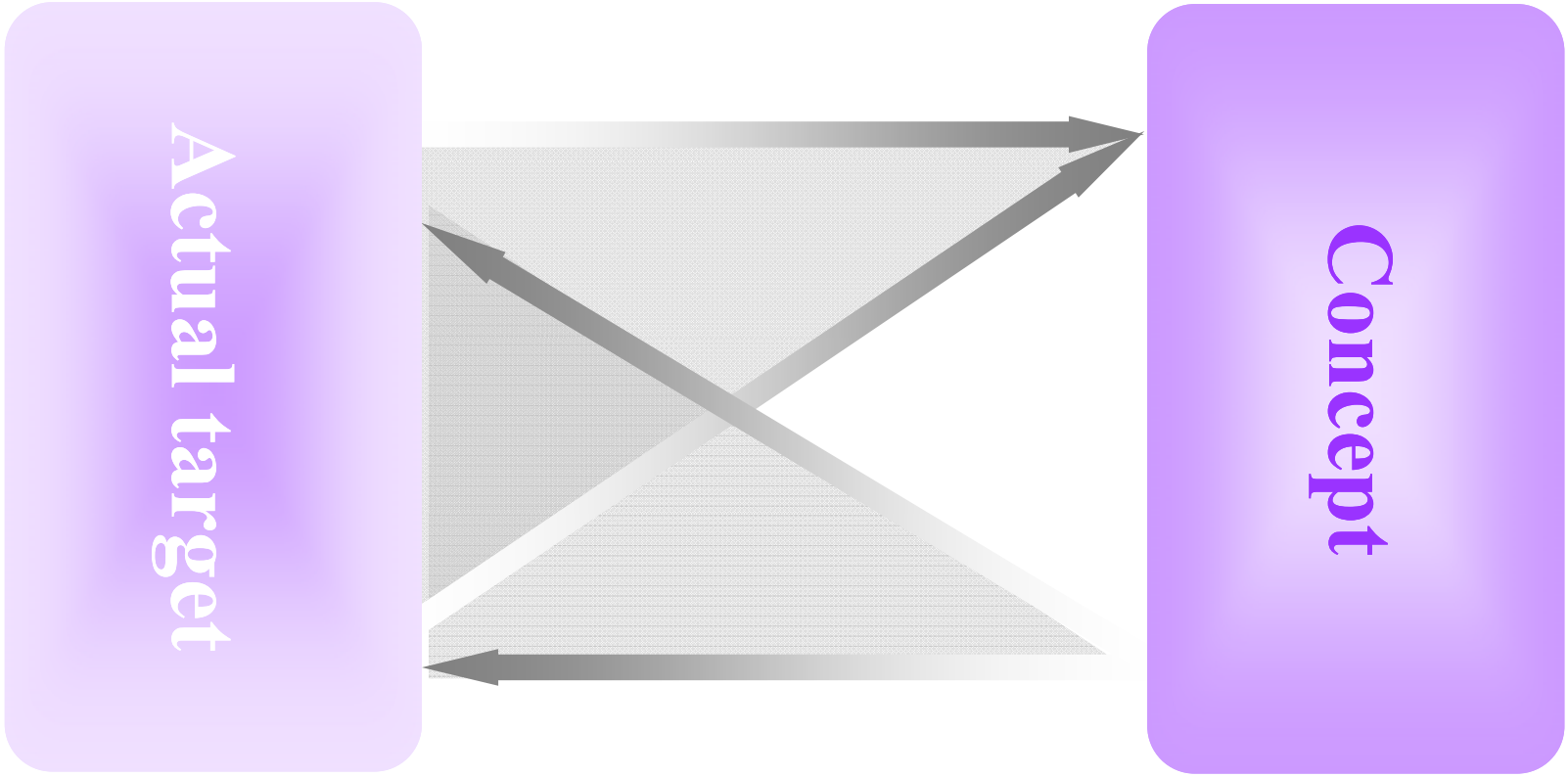


Model modification



Media conversion technology and human interface

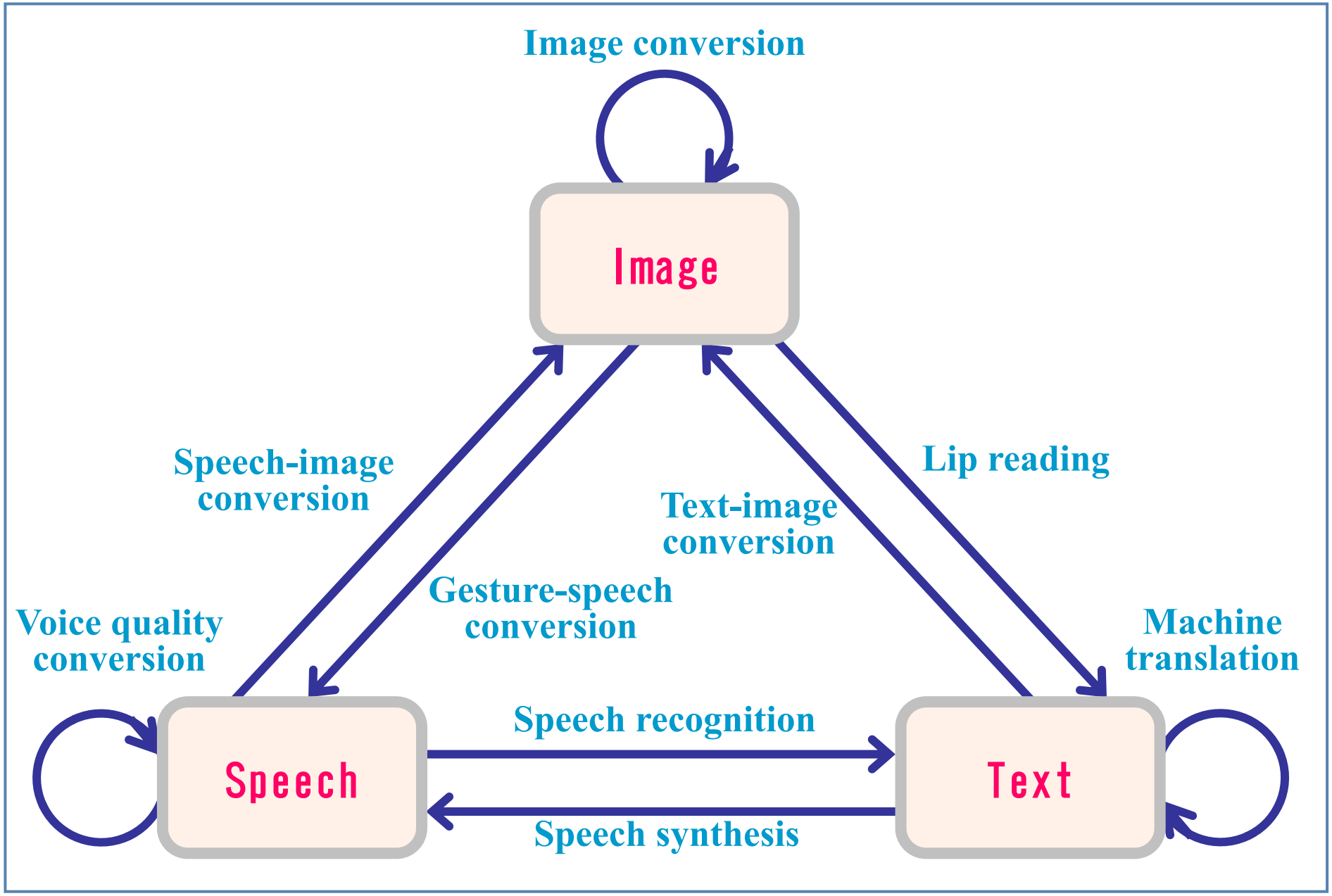
Recognition
（Information reduction process）

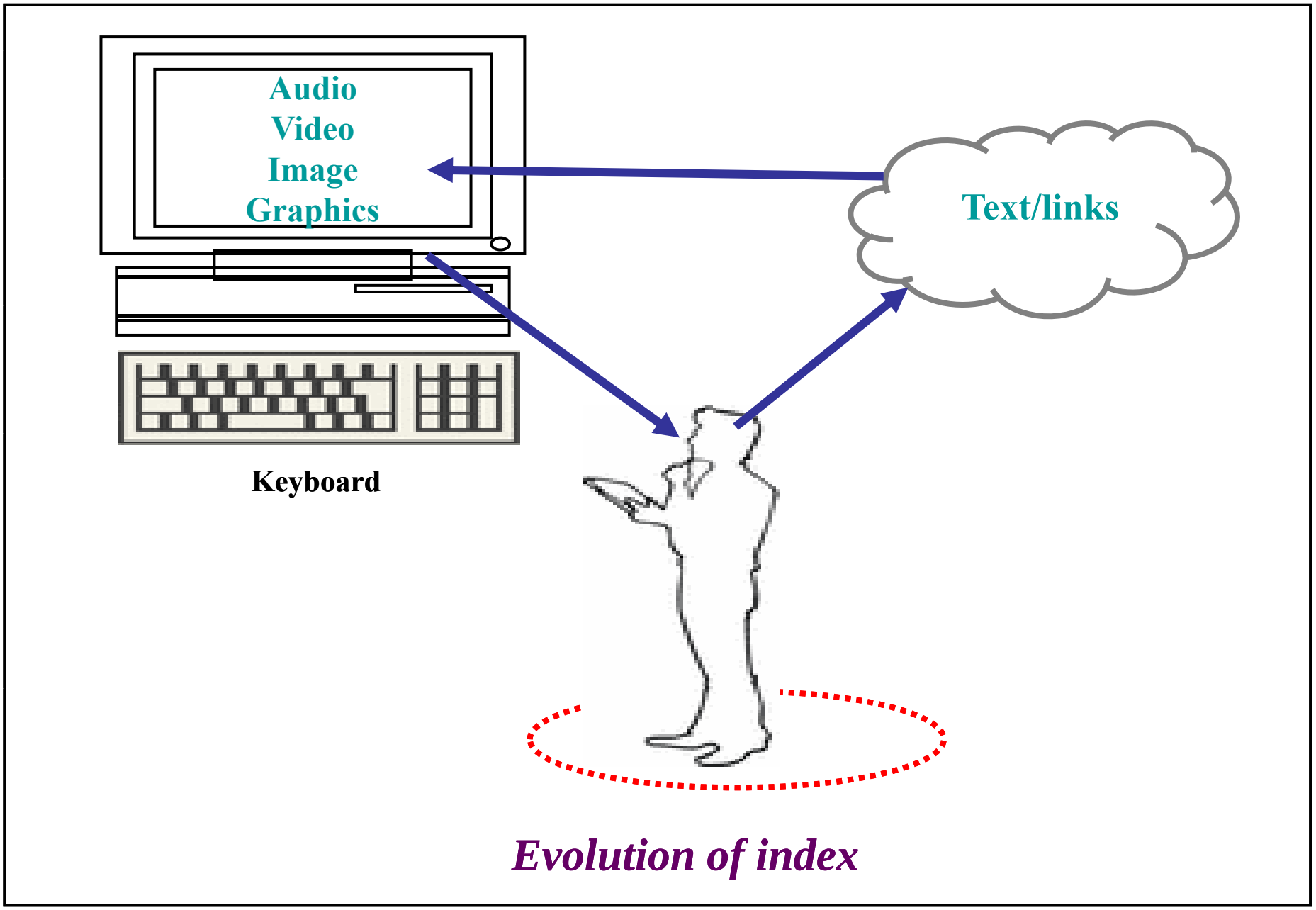


Production
（Information addition process）

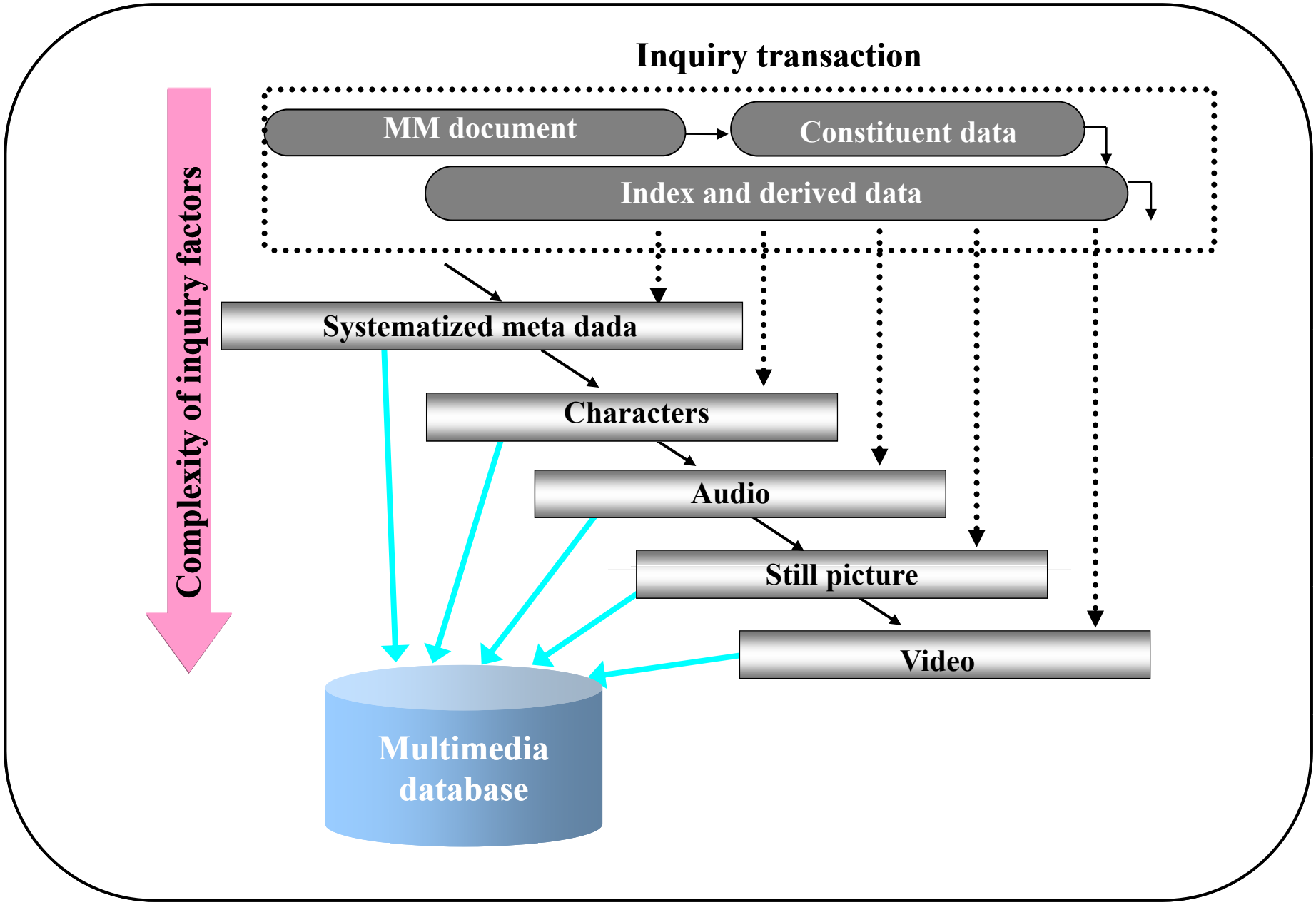
Information reduction and addition in recognition and production

Media conversion



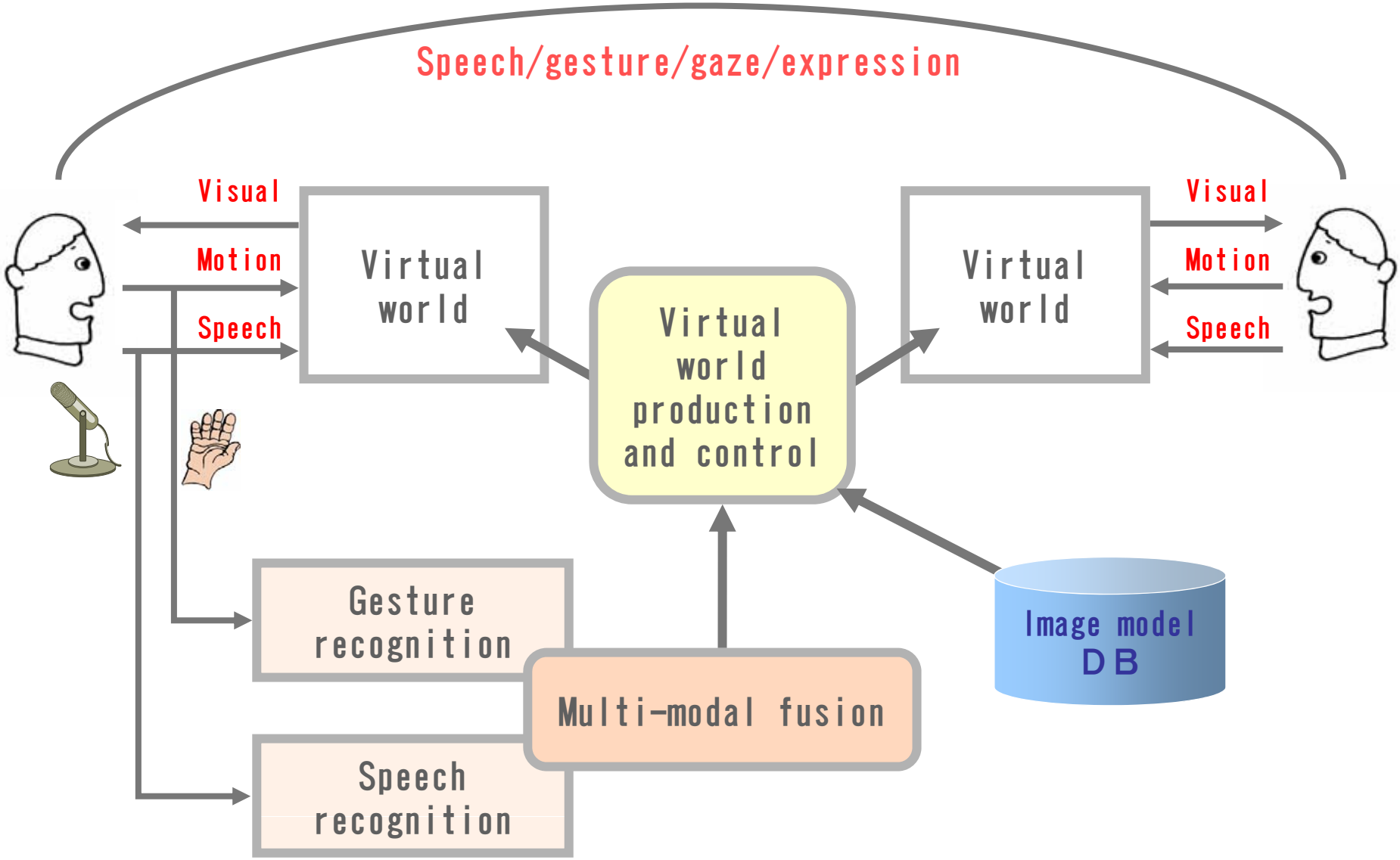


Evolution of index

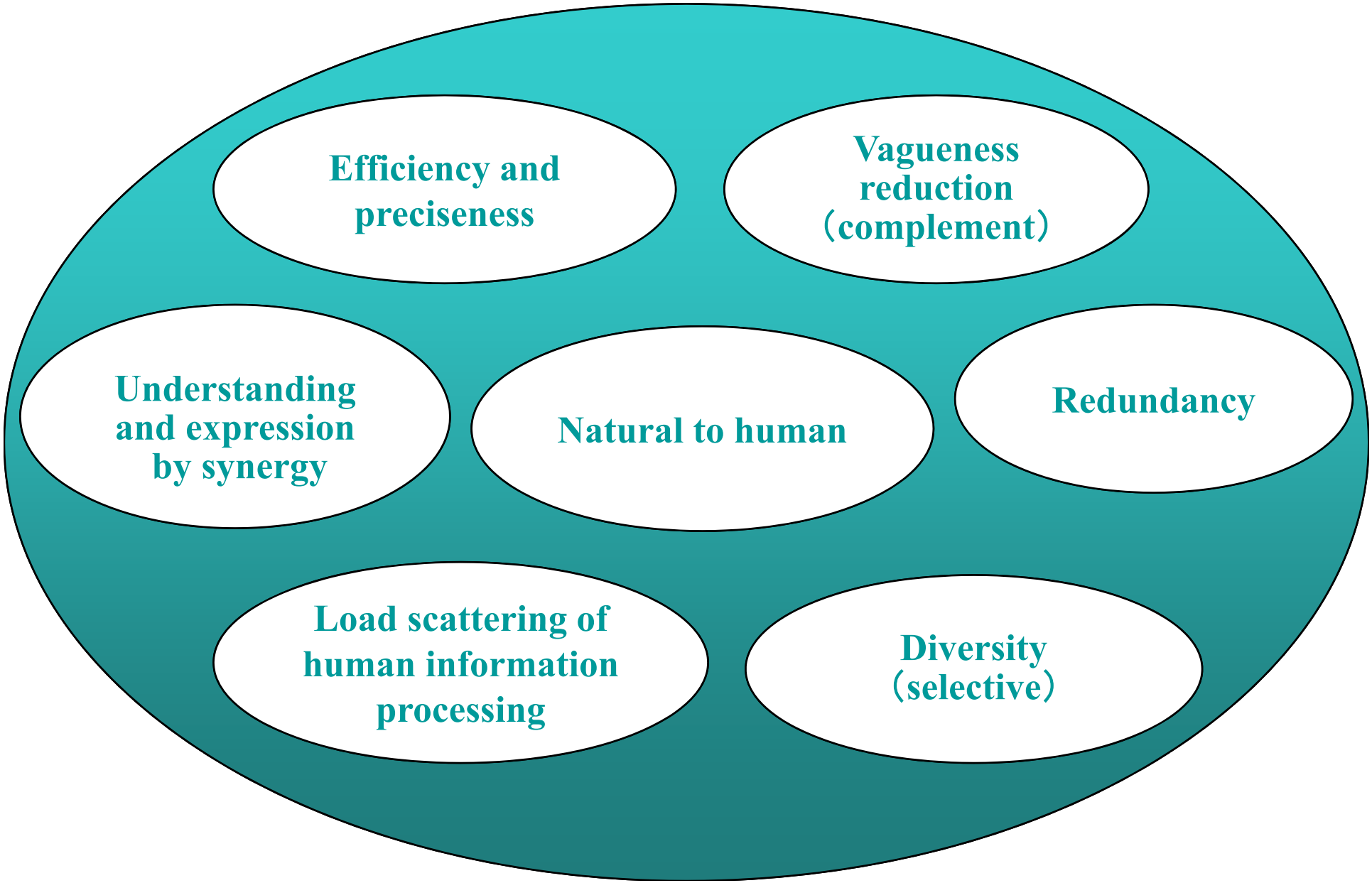


Processing of inquiries

Interaction through computer world



Special features of multimodal interface



What do you expect for machines ?

1. Dwarfs (human-like agents)

2. Substitutes of pencils, papers, desks, racks and whiteboards

- Make it easy to handle existing computers
  - Metaphor of files and a trash can
  - Visualization
- Make a new media on a machine
  - Hyper-text, hyper-media
- Make a virtual reality on a machine
- Make an environment to support group work among people
  - CSCW (Computer Supported Cooperative Works)

3. New tools having functions different from existing tools in a machine

- Support system for creative activities

Interface metaphor

- Understanding by metaphor
- GUI widget ：visual components
- It is not always easy to find an appropriate metaphor
- It is possible to cause misunderstanding

Affordance

- Possible operations are attributed to the shape of the object
- Push button affords the action of pushing
- Influenced by culture and education（example: faucet levers）

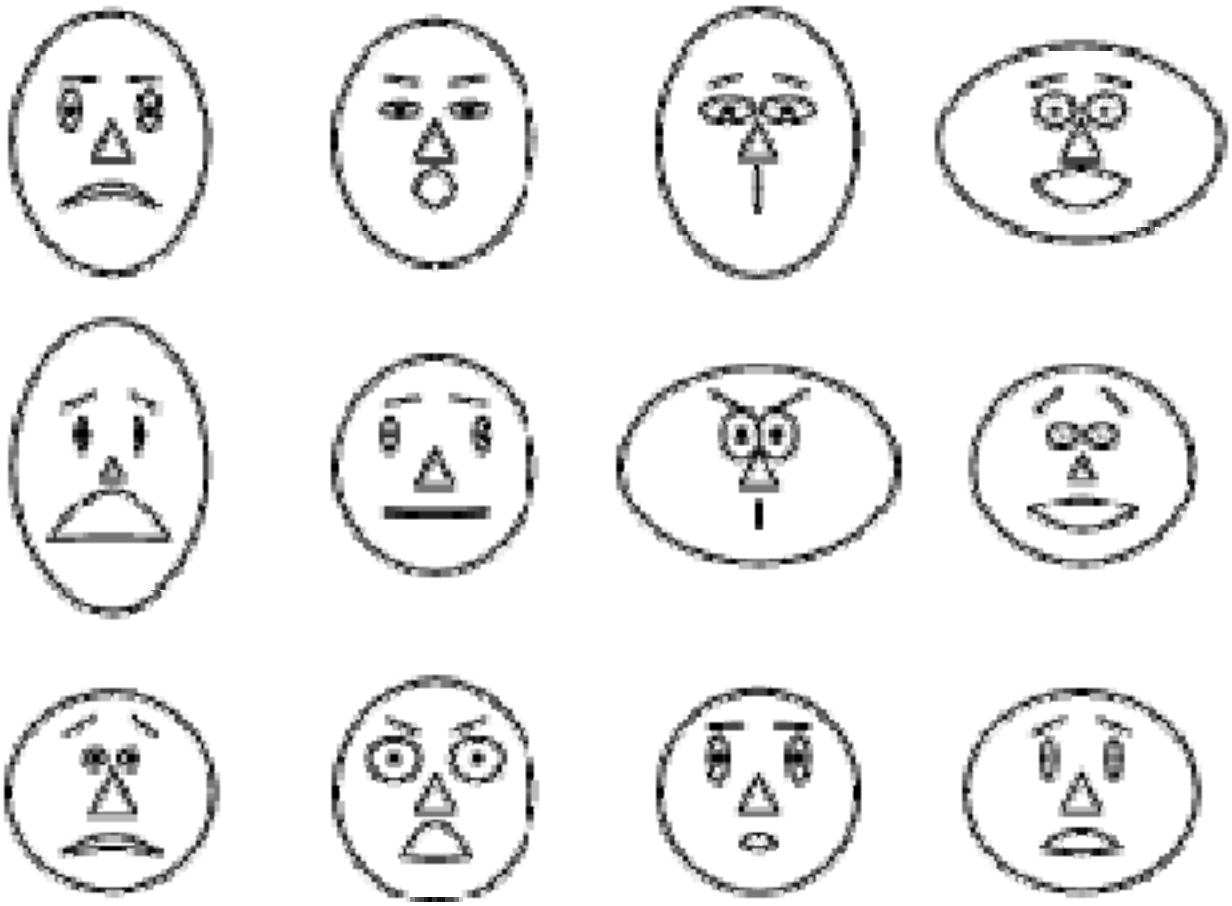
Use of Metaphors

Metaphor	Application	Examples
Typewriting (typing, using keyboard)	Word processor	Word
Document (elements of a document and their attributes and operations)	Desktop publishing	PageMaker, Etude
Ledger sheet (matrix structure for numbers)	Spreadsheet	Lotus 1-2-3, Excel
Drawing (with paper, pencil, and palettes)	Drawing and painting	MacPaint, MacDraw, Paintbrush
Table of data (managing data organized in rows and columns)	Database	QBE, Access

Guidelines on Metaphor Design

- Make use of common metaphors that have readily anticipated characteristics
- Determine which of the metaphor characteristics are essential
- Make explicit any mismatch between system functions and features of the metaphor
- Provide analogies that explain to the user the implications of the metaphors
- Do not mix major metaphors
- Use terms that refer to the source object of the metaphor
- Ensure that the tone of the metaphor matches the attitude that the user should have towards the system
- Preserve in the metaphor the order of the actions that are common in the source object

Chernoff faces convey quantitative data.



Examples of affordance

A door affording “pushing”

A door affording “pulling”

A door affording right/left opening

A faucet affording cold water by blue and hot water by red

Direct manipulation interface

- GUI, metaphor, affordance

- WYSIWYG
  (What You See Is What You Get)

- Visualization of information

Interface agent

- A group of autonomously working software

  Software agent
  ↕
  Physical agent

- Accept customization and tuning
- Adaptable
- Difficult to get the sense of direct manipulation

Integration

Conditions of direct manipulation
(by Ben Schneiderman)

- **Related objects are always shown on the screen**
- **Using physical manipulation, such as mouse movement and push button, instead of using commands following fixed format**
- **Manipulation should be quick and reversible, and the reaction needs to be immediately observed**

Features of metaphor and direct manipulation

Merits

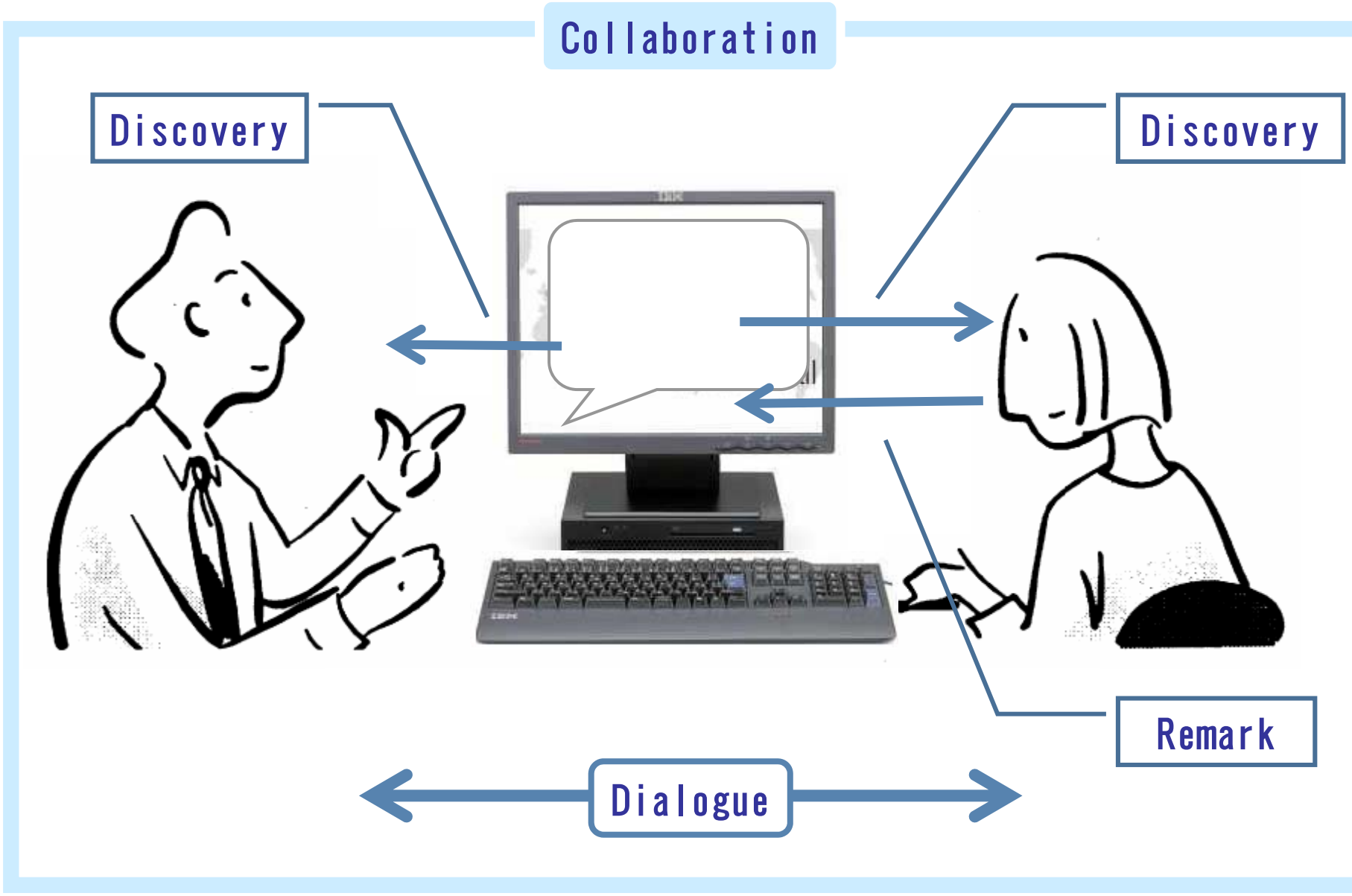
1. Easy to understand, since it is based on the world knowledge that everybody has.

2. No many things to newly learn.

Demerits

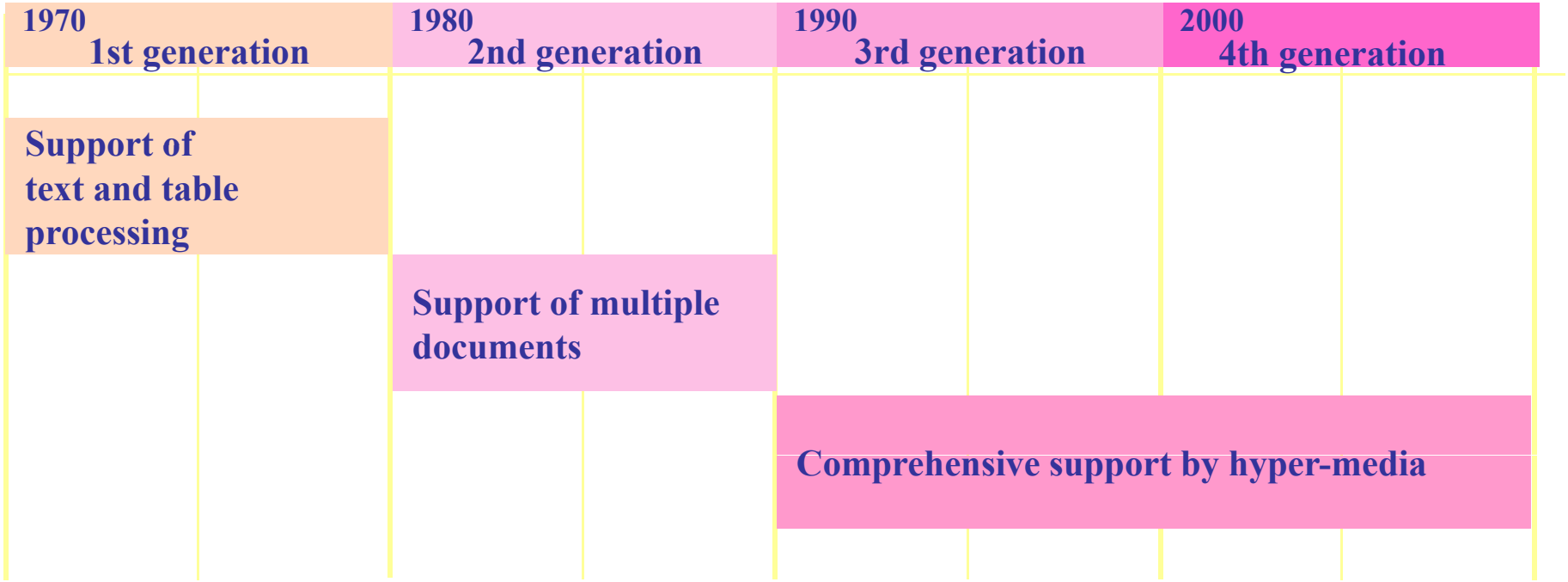
Restricted by the practiced world and difficult to make progress.

Visual Programming



From computer to meta-media

(Trend of technical support systems for office information processing)



Hyper-media

Hyper-text

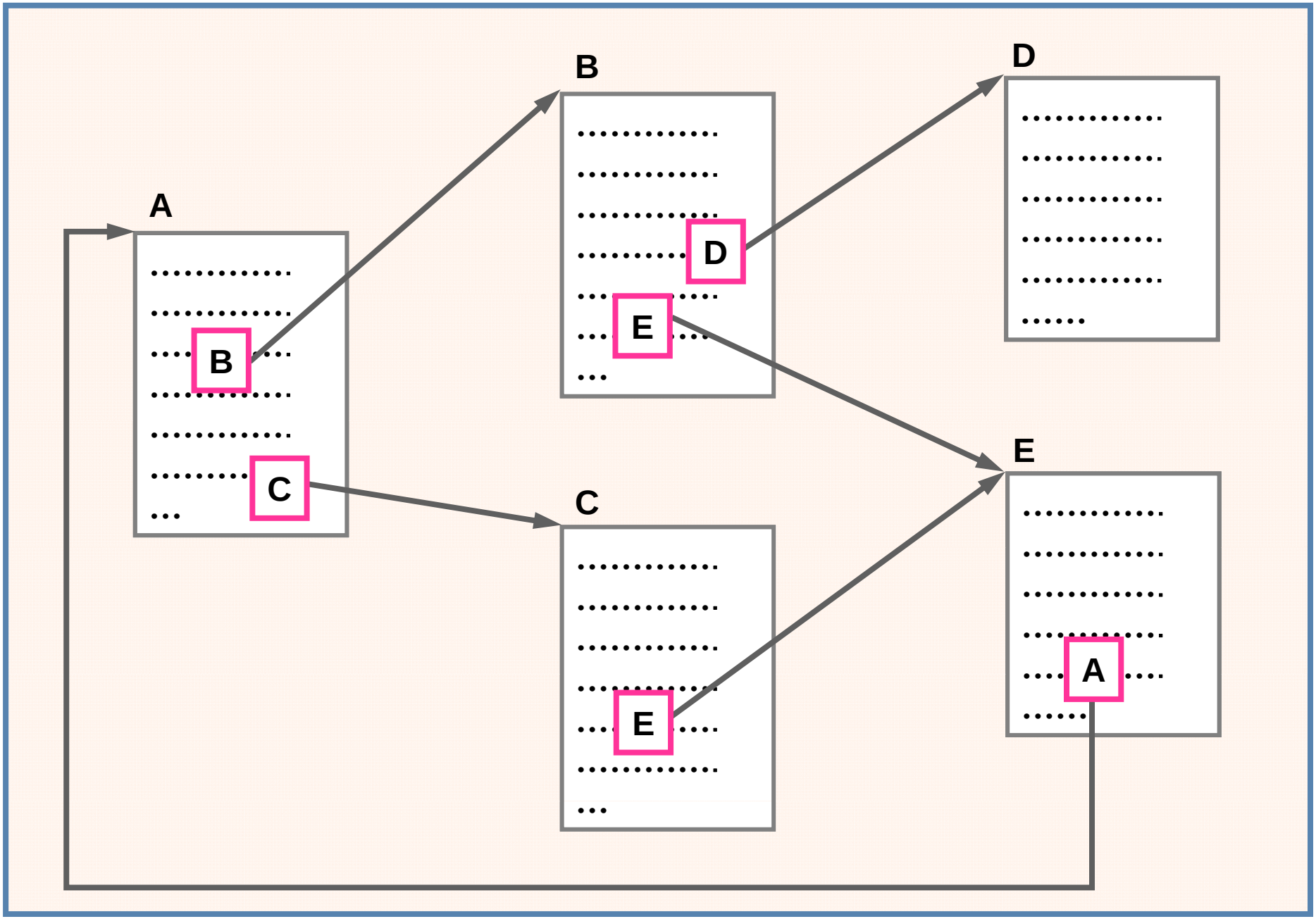
- Information which used to be described by linear or tree structure is described by network structure using links with related information.
- Based on GUI interface using a display with full use of graphics and icons, and a mouse (a kind of object-based user interface)

Hyper-media

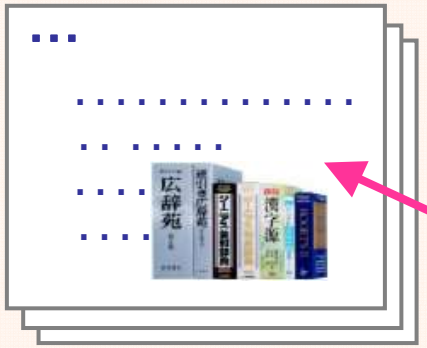
- Handling images, videos, and speech as node information.
- Direct manipulation which sequentially retrieves and refers multimedia information
- Examples：Knowledge Navigator（Voice Navigator）

Future：Intelligent object having autonomous behavioral ability and learning ability

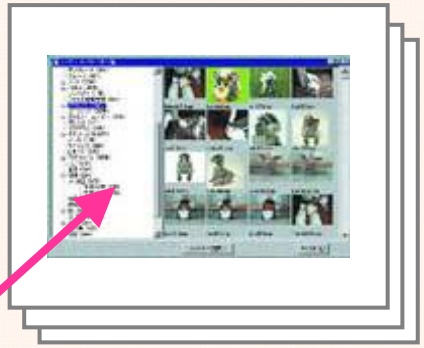
Hyper-text



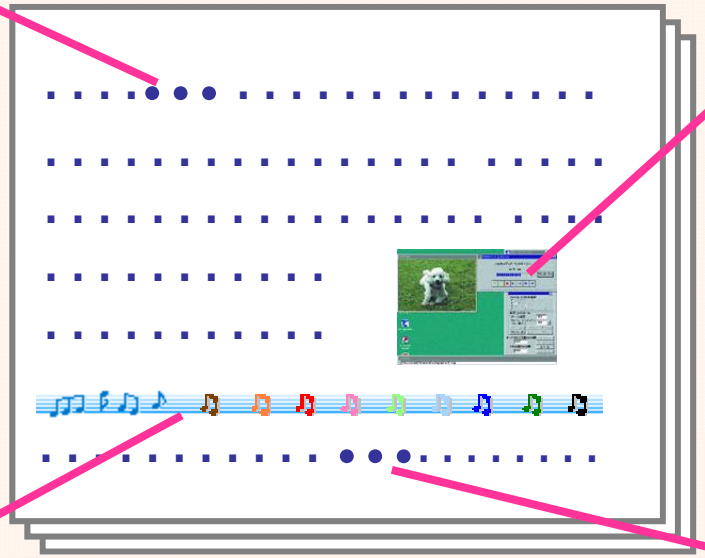
Hyper-media

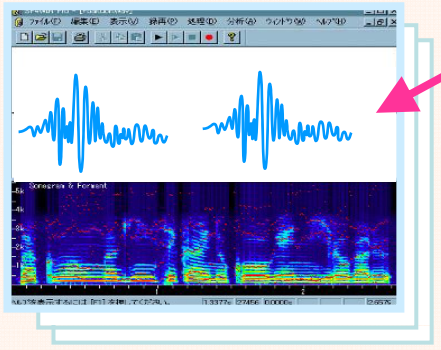


Dictionaries

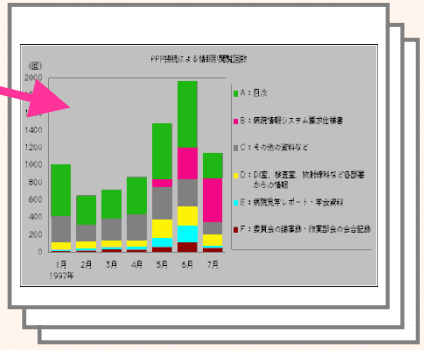


Videos





Speech



References

Knowledge Navigator

<Apple, 1988>

Hyper-text/Hyper-media

Merits

1. Easy to trace the references
2. Easy to make new relevant references
3. Information is structured
4. Easy to grasp global information by browsing
5. Easy to give various functions to a single document (media)
6. Information can be modularized
7. Information becomes consistent
8. Useful for group work

Demerits

1. Easy to get lost
2. Cognitive load becomes higher