Human Factors As HCI Theories

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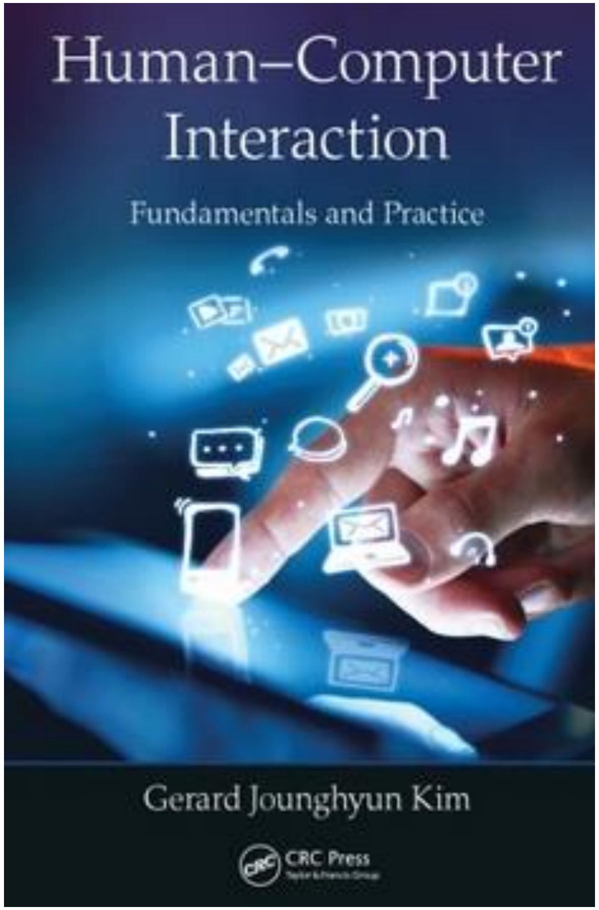
Textbook


Human–Computer
Interaction
Fundamentals and Practice
Gerard Jounghyun Kim
CRC Press

Course Outline

1. Human Information Processing
2. Sensation and Perception of Information
3. Human Body Ergonomics (Motor Capabilities)

1. Human Information Processing

1. Human Information Processing

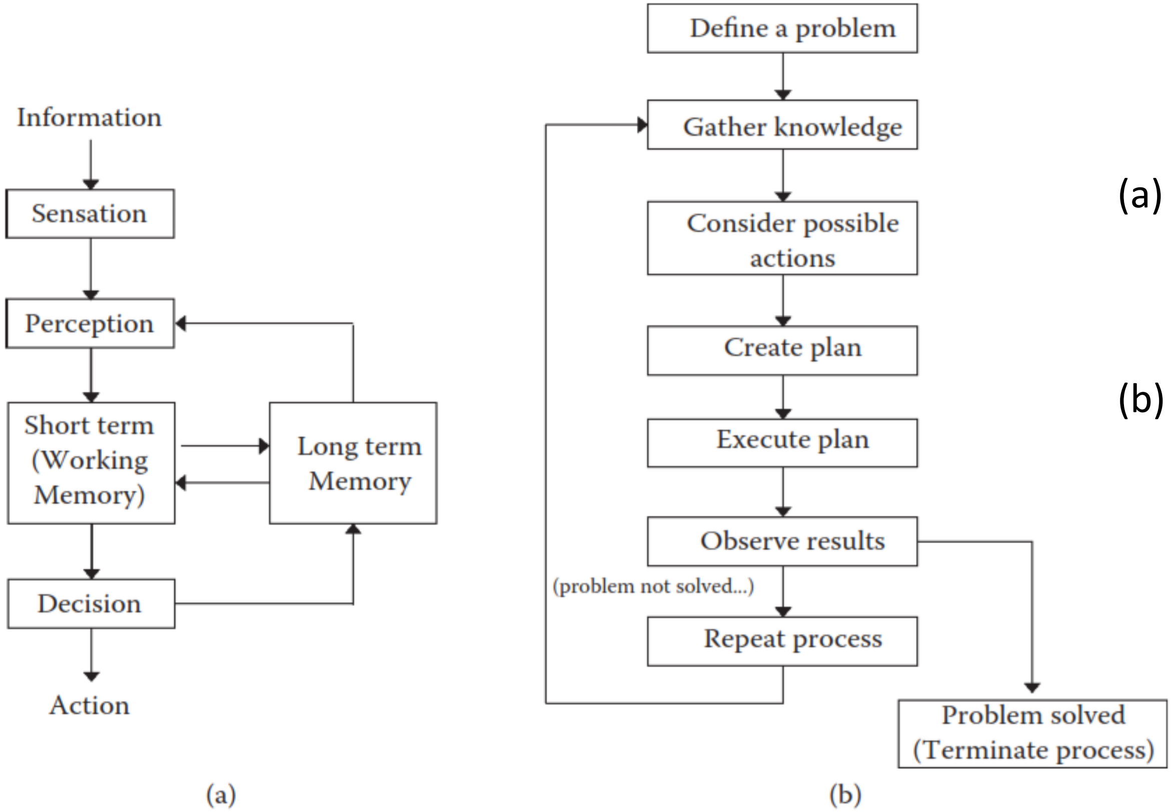
Any effort to design an effective interface for human computer interaction (HCI) requires two basic elements:

An understanding of

1. Computer Factors (software/hardware)
2. Human Behavior

1. Human Information Processing

1.1 Task Modeling and Human Problem-Solving Model

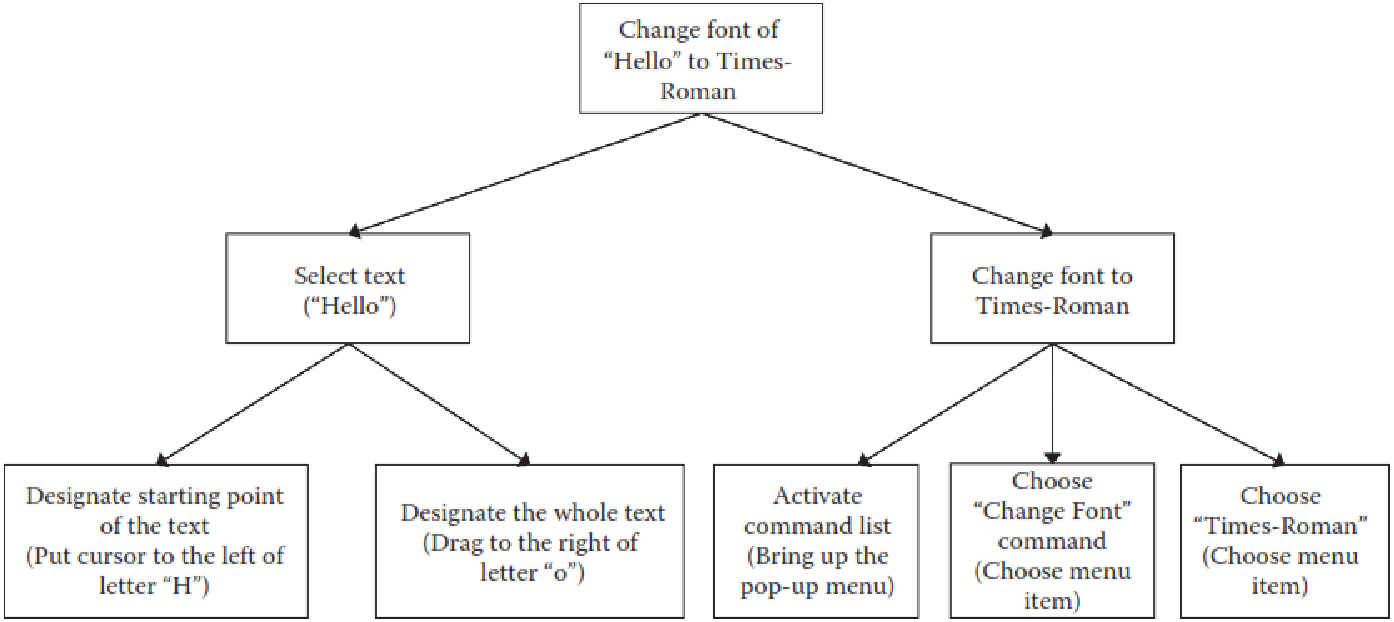


(a) The overall human problem-solving model and process

(b) a more detailed view of the "decision maker/executor."

1. Human Information Processing

1.1 Task Modeling and Human Problem-Solving Model



An example of a hierarchical task model of changing a font for a short text. Note that a specific interface may be chosen to accomplish the subtasks in the bottom

1. Human Information Processing

1.2 Human Reaction and Prediction of Cognitive Performance

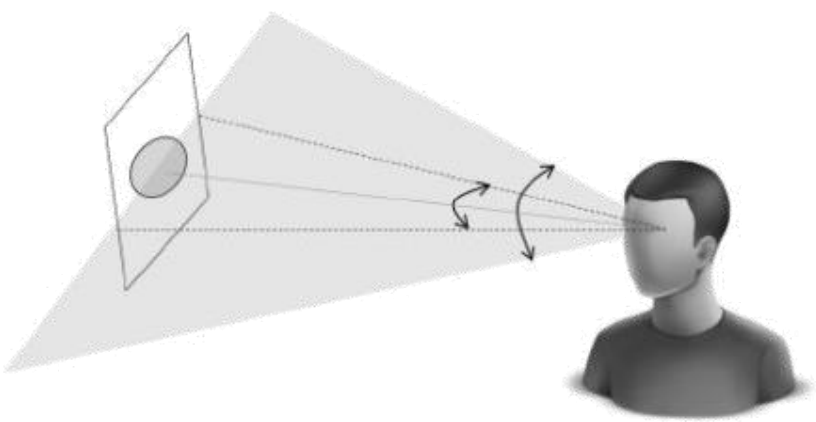
Norman dan Draper [1] berbicara tentang "jurang eksekusi / evaluasi," yang menjelaskan bagaimana pengguna memahami, ketika sistem interaktif tidak menawarkan tindakan tertentu atau tidak menghasilkan

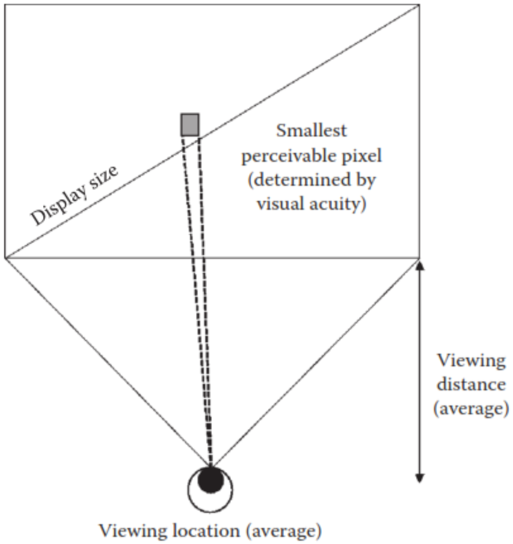
2. Sensation and Perception of Information

2. Sensation and Perception of Information

2.1 Visual

2.1.1 Visual and Display Parameters





The display system parameters: display size, resolution, pixel determined by the user's visual acuity, and viewing location

2. Sensation and Perception of Information

2.1 Visual

2.1.2 Detail and Peripheral Vision

(a) (b)

(a) An ideal display that would provide relatively higher resolution in the area of the user's focus;
(b) a large immersive display as realized by a high-resolution monitor in the middle- and lower-resolution projection in the periphery. (From Microsoft® Research, CHI 2013: An Immersive Event (Illusions create an immersive experience), 2013, http://research.microsoft.com/en-us/news/ features/chi2013-042913.aspx [9].)

2. Sensation and Perception of Information

2.1 Visual

2.1.2 Detail and Peripheral Vision

A large, tiled, high resolution display. Is it really worth the cost?

(From Ni, T., Schmidt, G. S., Staadt, O. G., Livingston, M. A., Ball, R., and May, R. A., Proceedings of IEEE Virtual Reality Conference, IEEE, Piscataway, NJ, 2006, pp. 223–236 [10].)

2. Sensation and Perception of Information

2.1 Visual → 2.1.3 Color, Brightness, and Contrast

Color: Human response to different wavelengths of light, namely for those corresponding to red, green, blue, and their mixtures

Brightness: The amount of light energy emitted by the object (or as perceived by the human)

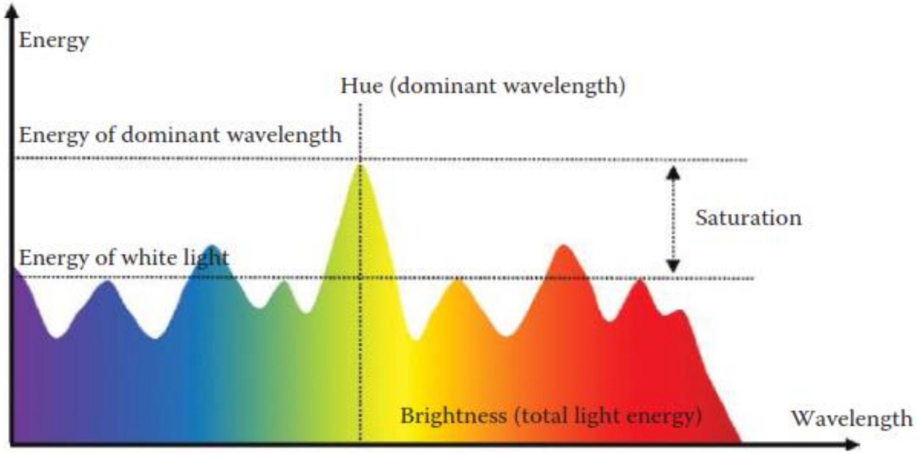
Contrast: Relative difference in brightness or color between two visual objects.

2. Sensation and Perception of Information

2.1 Visual

2.1.4 Pre-Attentive Features and High-Level Diagrammatic Semantics

Detail, color, brightness, and contrast are all very-low-level raw visual properties

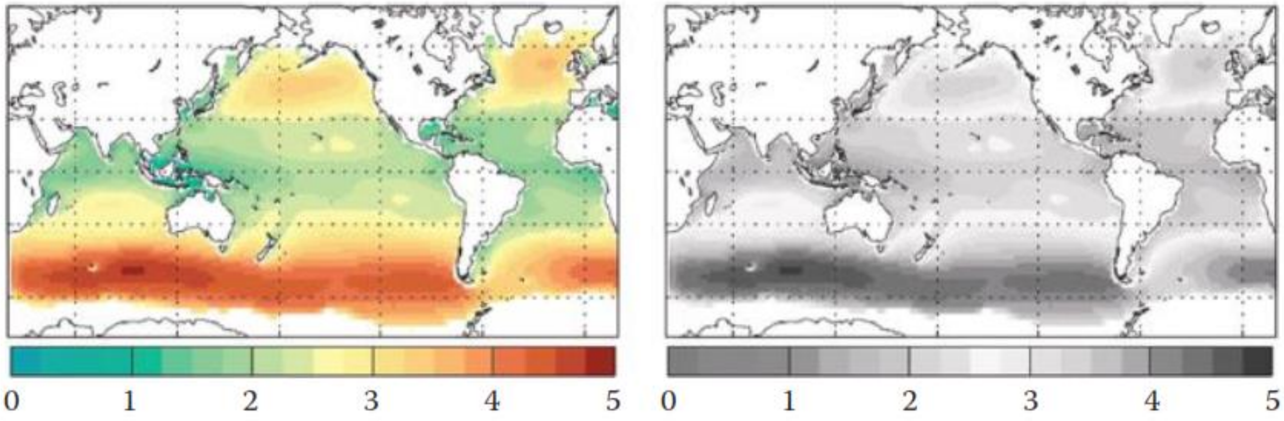


Color specification by **hue** (particular/dominant wavelength), **saturation** (relative difference in the major wavelength and the rest), and **value/brightness** (total amount of the light energy)

2. Sensation and Perception of Information

2.1 Visual

2.1.4 Pre-Attentive Features and High-Level Diagrammatic Semantics

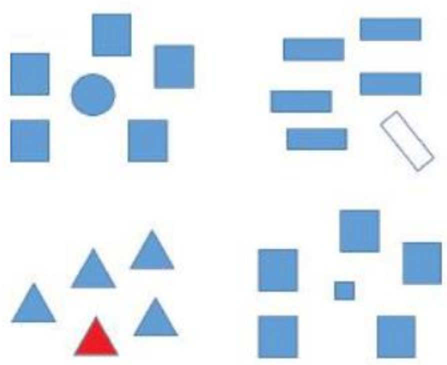


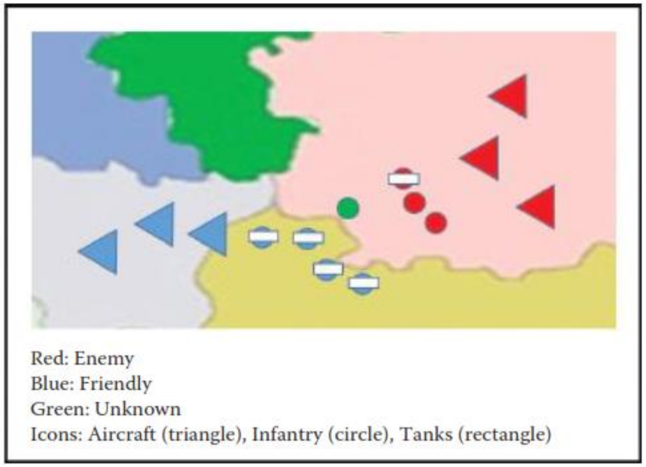
Coding of information in a map (e.g., temperature levels) using contrast in brightness (left) and color (right). (From Hemer, M. A., Fan, Y., Mori, N., Semedo, A., and Wang, X. L., Nature Climate Change, 3, 471–476, 2013 [11])

2. Sensation and Perception of Information

2.1 Visual

2.1.4 Pre-Attentive Features and High-Level Diagrammatic Semantics



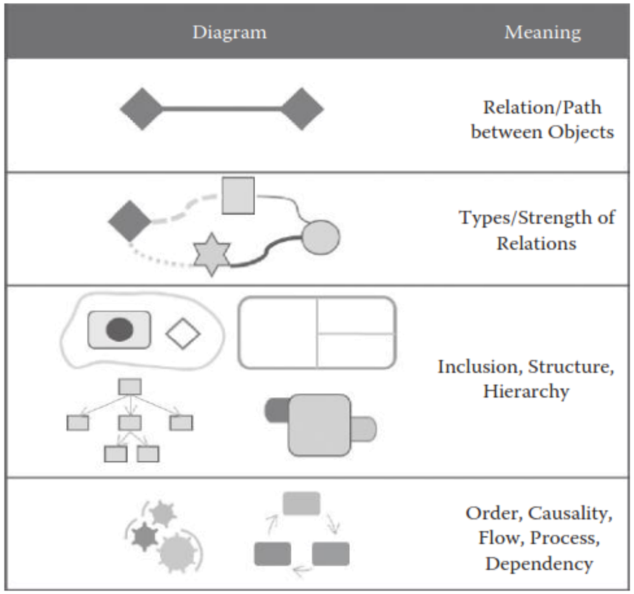


Examples of preattentive features for attention focus based on differences in size, shape, and orientation (left) and application to icon design (right). (From Ware, C., Information Visualization: Perception for Design, 3rd ed., Morgan Kaufmann, Waltham, MA, 2012 [12].)

2. Sensation and Perception of Information

2.1 Visual

2.1.4 Pre-Attentive Features and High-Level Diagrammatic Semantics



Examples of diagrams/shapes/objects/figures with universal semantics. (From Ware, C., Information Visualization: Perception for Design, 3rd ed., Morgan Kaufmann, Waltham, MA, 2012 [12].)

2. Sensation and Perception of Information

2.2 Aural

The aural modality (sound) is perhaps the most prevalent mode for information feedback.
The actual form of sound feedback can be roughly divided into three types:

- a) simple beep like sounds
- (b) short symbolic sound bytes known as earcons
- (c) relatively longer

  "as is" sound feedback that is replayed from recordings or synthesis

2. Sensation and Perception of Information

2.2 Aural

2.2.1 Aural Display Parameters

Intensity (amplitude) refers to the amount of sound energy and is synonymous with the more familiar term, volume

Sound can be viewed as containing or being composed of a number of sinusoidal waves with different frequencies and corresponding amplitudes

Phase refers to the time differences among sound waves that emanate from the same source

Examples of Different Sounds and Their Typical Intensity Levels in Decibels

INTENSITY (DB)	DESCRIPTION
0	Weakest sound audible
30	Whisper
50	Office environment
60	Normal conversation
110	Rock band
130	Pain threshold

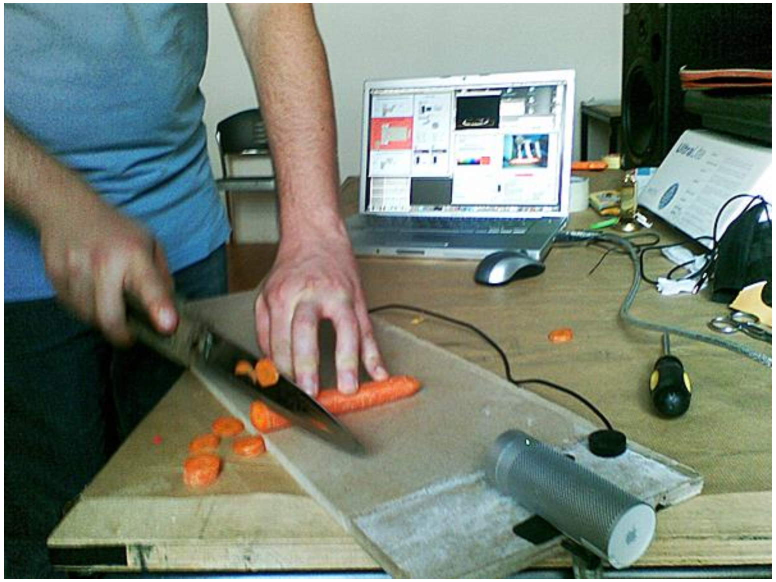
2. Sensation and Perception of Information

2.2
Aural

2.2.2 Other Characteristics of Sound as Interaction Feedback

1. Sound is effectively omnidirectional

1. Continuous sound is somewhat more subject to becoming habituated (e.g., elevator background music) than stimulation with other modalities



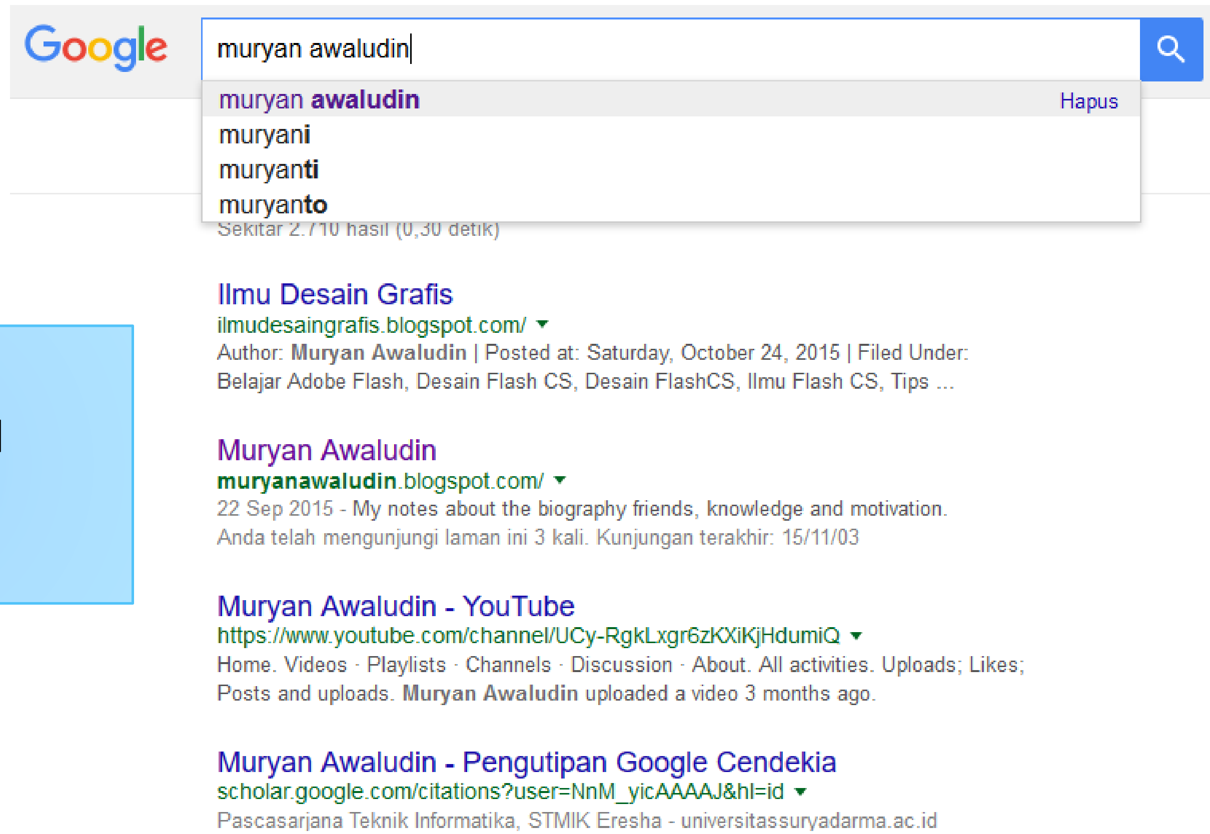
2. Sensation and Perception of Information

2.2 Aural → 2.2.3 Aural Modality as Input Method

As for using it actively as a means for input to interactive systems, two major methods are:

- (a) Keyword recognition
- (b) Natural language understanding

2. Sensation and Perception of Information



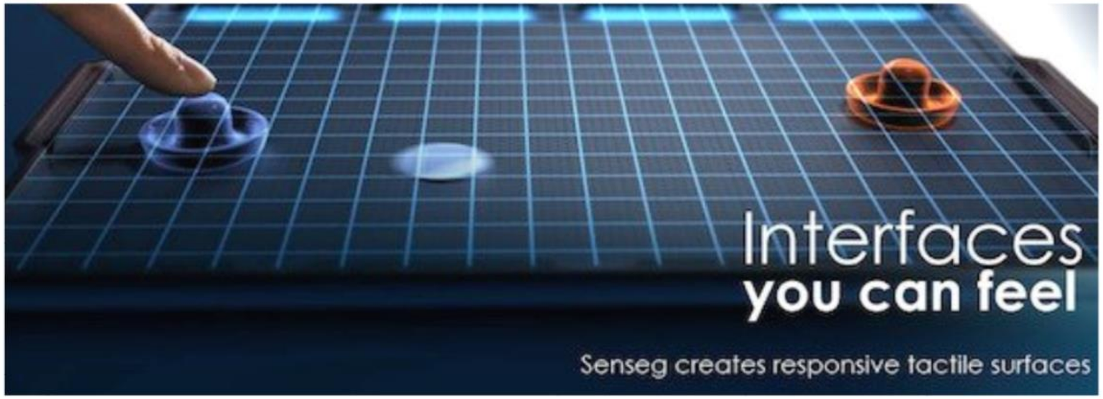
(a) Keyword recognition

2. Sensation and Perception of Information

(b) Natural language understanding

2. Sensation and Perception of Information

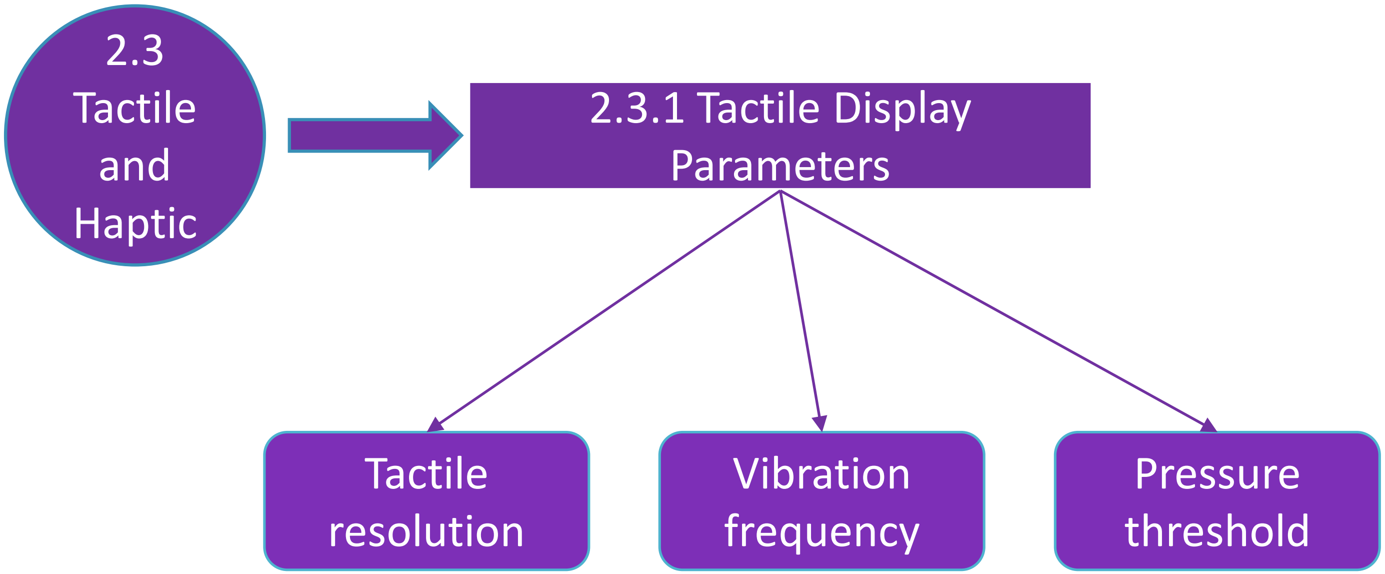
2.3 Tactile and Haptic



Haptic is defined to be the modality that takes advantage of touch by applying forces, vibrations, or motions to the user [17]

The term tactile for sensing different types of touch (e.g., texture, light pressure/contact, pain, vibration, and even temperature) through our skin

2. Sensation and Perception of Information



The skin sensitivity to physical objects is different over the human body [18]

Vibration frequency of about 250 Hz is said to be the optimal for comfortable perception [16]

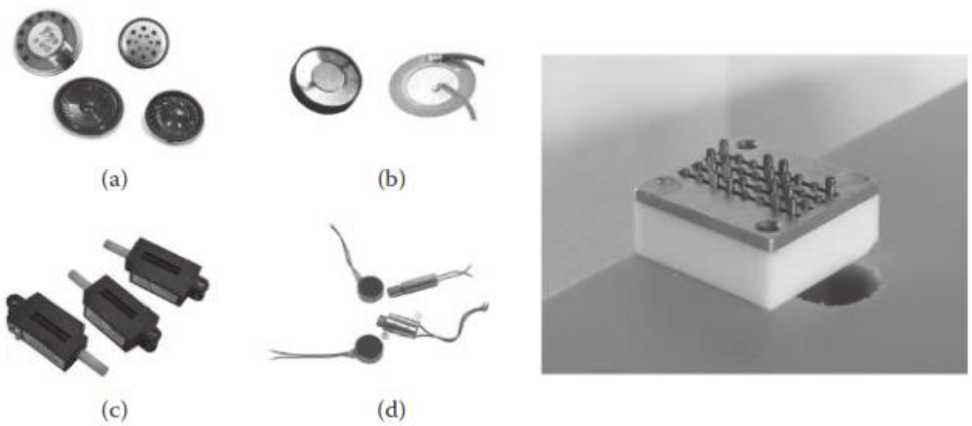
For a fingertip, this amounts to about 0.02 N for the fingertip area [19]

2. Sensation and Perception of Information

2.3 Tactile and Haptic

2.3.2 Haptic and Haptic Display Parameters

Along with tactile feed- back, haptic feedback adds a more apparent physical dimension to interaction



Left: Various actuators used for tactile feedback: (a) miniature speaker, (b) minia- ture electromagnet/latch, (c) piezoelectric strip, (d) microvibratory motors. Right: tactile array with multiple actuators. (From KU Leuven, Tactile Feedback, 2010, https://www.mech.kuleuven.be/en/ pma/research/ras/researchtopics/tactfb.html [21].)

2. Sensation and Perception of Information

2.3 Tactile and Haptic

2.3.2 Haptic and Haptic Display Parameters

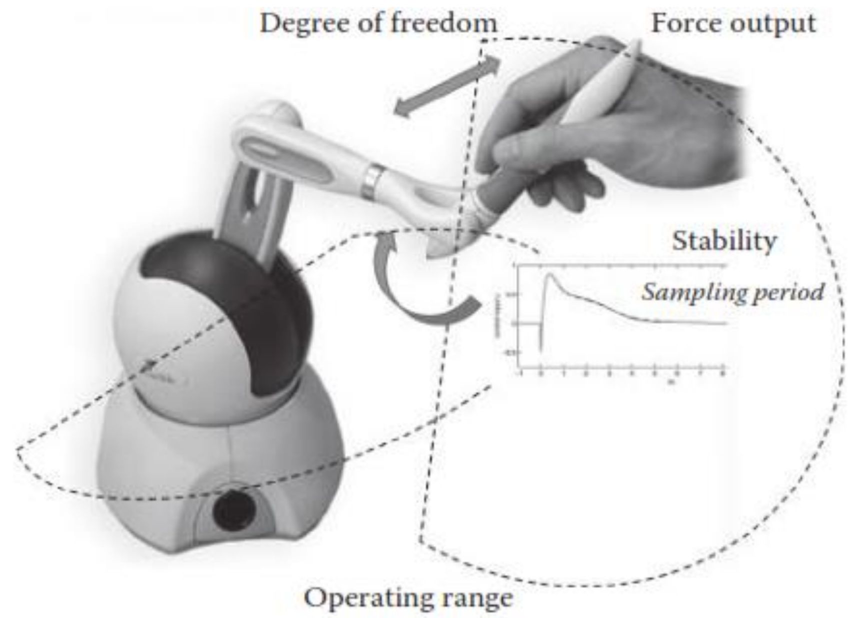
(a) (b)

Two types of haptic systems: (a) grounded and (b) body worn

2. Sensation and Perception of Information

2.3 Tactile and Haptic

2.3.2 Haptic and Haptic Display Parameters



Important parameters for a haptic display system.

2. Sensation and Perception of Information

2.4
Multimodal Interaction

Conventional interfaces have been mostly visually oriented. However, for various reasons, multimodal interfaces are gaining popularity with the ubiquity of multimedia devices [22]

Here are some representative examples:

Complementary	Redundant	Alternative
Modalitas yang berbeda dapat mengasumsikan peran yang berbeda dan bertindak secara pelengkap untuk mencapai tujuan interaksi tertentu.	Metode input pengandaian yang berbeda atau umpan balik yang dapat digunakan untuk memastikan pencapaian dapat diandalkan untuk tujuan interaksi.	Menyediakan pengguna dengan cara-cara alternatif untuk berinteraksi memberi orang lebih banyak pilihan

3. Human Body Ergonomics (Motor Capabilities)

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For HCI, focus on the human motor capabilities that are used to make input interaction

3.1 Fitts's Law

Fitts's law [23] is a model of human movement that predicts the time required to rapidly move to a target area as a function of the distance to and the size of the target.

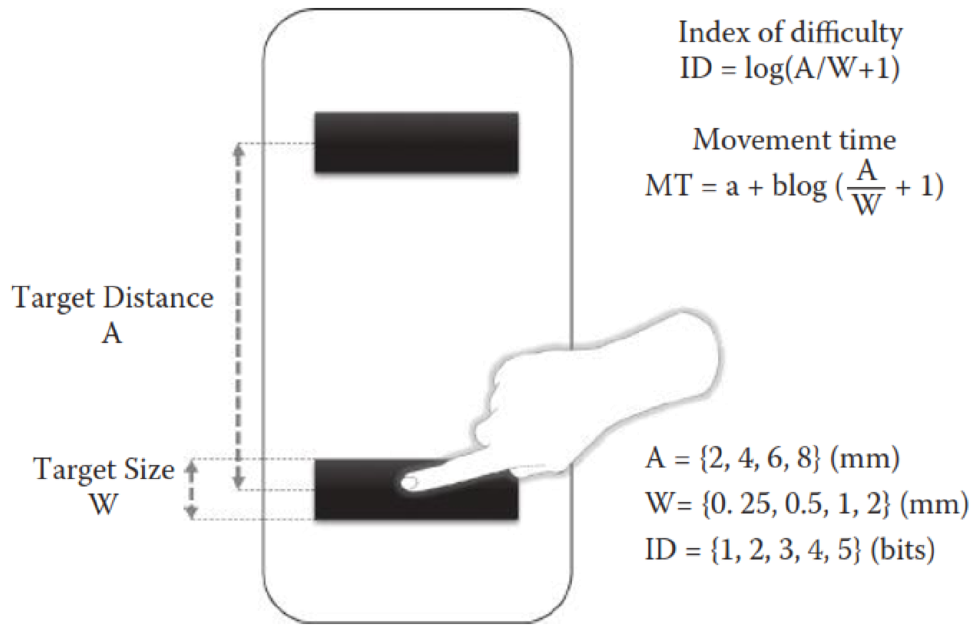
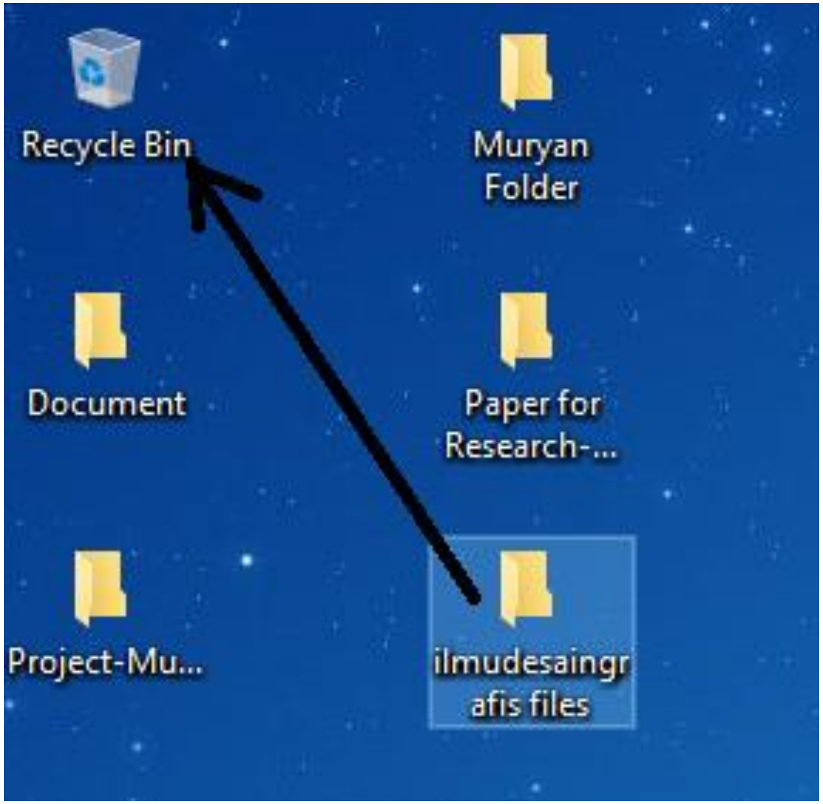


Illustration of Fitts's law. (From MacKenzie, I. S., Human Computer Interaction, 7(1), 91–139, 1992 [24].)

3. Human Body Ergonomics (Motor Capabilities)

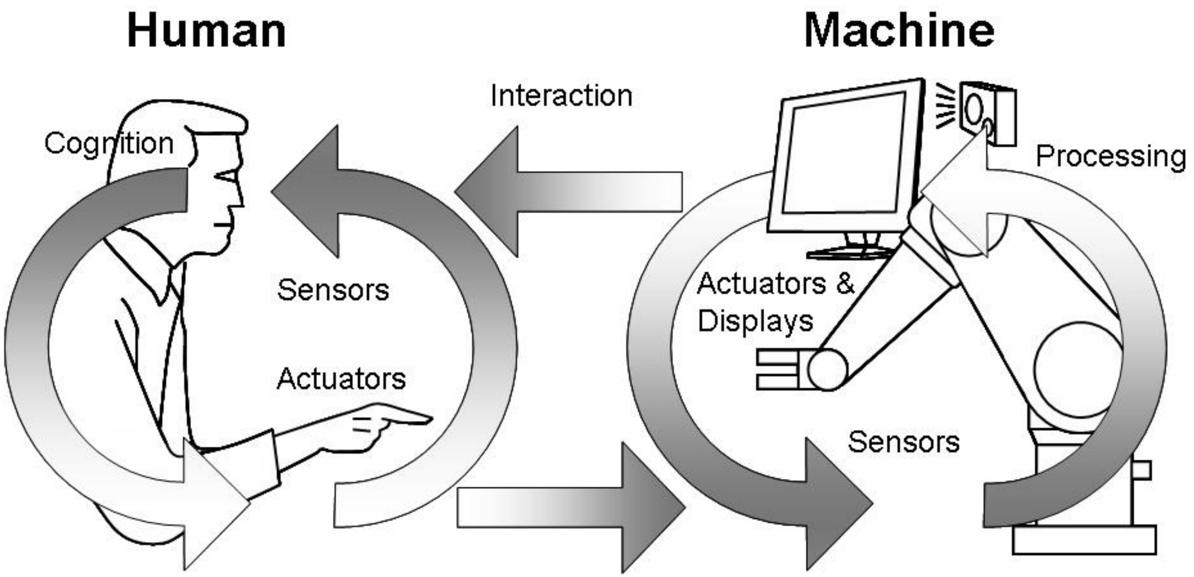


Applying Fitts's law to a computer interface (dragging a file icon into the trashcan icon)

3. Human Body Ergonomics (Motor Capabilities)

3.2 Motor Control

The most prevalent form of input is made by the movements of our arms, hands, and fingers for keyboard and mouse input [18]



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