

## **Course: Human Computer Interface (HCI)**

### **Week 2: Introduction to HCI - The Computer Concept**

**Lecturer: Martha Gichuki**

#### **Lecture Learning Outcomes**

At the end of this lecture, the learner will be able to:

- (i) Define a computer in connection to Human Computer Interfaces
- (ii) Describe the various devices used to transfer information in computers
- (iii) Describe the various disciplines contributing to HCI development

#### **1. Introduction:**

##### **1.1. Definition: Computer**

A computer is an electronic device that processes data into information based on instructions given by the user. Computer concepts deal with relevant techniques in computer graphics, operating systems, programming languages, development environments, engineering and design methods among others.

##### **1.2. Definition: Human Computer Interaction (HCI)**

From week 1 content, recall that Human Computer Interaction (HCI) is the study of the links between people (users) and computers. This interaction occurs at the user interface level via software and hardware computer components. Examples of such interactions include the characters or objects displayed by software on a personal computer's monitor or the input received from users via hardware peripherals such as keyboard, touch screen and mouse.

#### **2. Computer Devices**

Users interact with computers as they transfer information using various devices depending on the input data and how data is transferred from the computer system. These devices include

## 2.1. Text Entry Devices<sup>1</sup>

- ✓ Alphanumeric keyboards - Many keyboards have a standard layout identified by the first keys on the top row e.g., QWERTY layout. This layout minimizes finger stretching and enables use of weak fingers reducing fatigue and increasing typing speed.
- ✓ Chord keyboards - fewer keys are used, letters are produced by pressing multiple keys at once
- ✓ Phone Keypad – These have two modes: - numeric and alphanumeric.
- ✓ Handwriting recognition - This interface is about how letters are drawn and there are huge differences in people's handwritings. The technology is more suited for mobile computing due to small keypads
- ✓ Speech recognition - Systems need tuning to accommodate multiple users based on voice, emotions and accents<sup>2</sup>.

## 2.2. Pointing and Positioning Devices<sup>3</sup>

- ✓ Mouse - provides indirect inputs using two wheels that slide across the desktop
- ✓ Touch pad - a touch-sensitive tablet operated via sliding finger(s) over it
- ✓ Track ball - an upside-down mouse with a ball that is rolled to manipulate the cursor either horizontally or vertically.
- ✓ Joystick - Cursor position is the same as joystick base position
- ✓ Touchscreen - directly detects fingers or stylus position on the screen by interrupting a matrix of light beams.
- ✓ Stylus and light pen - used on touch-sensitive surfaces with the drawback of pointing hindering display
- ✓ Eye gaze - allows users to control the computer by looking at it, while wearing special glasses or head mounted boxes. Eye laser beam reflections are tracked and direction is determined based on where the eye is looking<sup>4</sup>

## 2.3. Display Devices<sup>5</sup>

- ✓ Cathode Ray Tube (CRT) and Liquid Crystal Display (LCD) monitors - These generate soft copy outputs and vary in terms of size and output quality<sup>6</sup>

---

<sup>1</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 16

<sup>2</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 16

<sup>3</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 17-18

<sup>4</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 17-18

<sup>5</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg 18-19

<sup>6</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg 18-19

- ✓ Projectors - They have a small screen through which light is projected on a bigger screen
- ✓ Digital paper - These are thin materials that can be written to electronically

#### **2.4. Virtual Reality Devices and 3D Interaction**

Users can enter a virtual world using Virtual Reality (VR) systems and the human mind can handle multiple degrees of indirection.

#### **2.5. Physical Controls and sensors**

- ✓ Sound output – Some sounds confirm a right action
- ✓ Touch, feel and smell – Haptic devices provide force, resistance and texture thereby influencing human senses.

#### **2.6. Paper Printing and scanning**

Printers generate hard copy outputs and there are differences between these and soft copies. Scanners produce bitmap images of text files and output is based on the “what you see is what you get” (WYSIWYG) concept. However, fonts, paper size and other printing features can be adjusted accordingly<sup>7</sup>.

#### **2.7. Memory**

Information is either held in Random Access Memory which is fast and volatile (short-term) or in long-term Memory which includes disks.

Text storage is done in the ASCII character codes, while video storage is done in frames. Compression techniques applied to large files reduces storage space requirements.

#### **2.8. Processing and Networks<sup>8</sup>**

Networked systems have an effect on interactivity based on distance variations, network’s speed and actions of other users that may influence interactivity.

The user interface provides a link between the user and the computer system and it is the part of the system that the user sees, hears, touches and communicates with. Users interact with the computer in order to carry out important tasks critical to their needs<sup>9</sup>.

---

<sup>7</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 20-21

<sup>8</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 22

### **3. Interaction and computers**

The flow of information between users and the computer is defined as the loop of interaction with several aspects to it including:

- ✓ **Task environment:** The conditions and goals set upon the user.
- ✓ **Input Flow:** The flow of information that begins in the task environment, when the user has some tasks that requires using their computer.
- ✓ **Machine Environment:** The environment that the computer is connected to e.g., networked systems
- ✓ **Interface Areas:** Non-overlapping areas facilitating the human and computer processes not pertaining to their interaction, and overlapping areas focusing on the processes pertaining to their interaction.
- ✓ **Output:** The flow of information that originates in the machine environment.
- ✓ **Feedback:** Loops through the interface that evaluate, moderate, and confirm processes as they pass from the human through the interface to the computer and back.

### **Limitations on Interactive Performance**

Several factors that can limit the speed of a computer interactive system include<sup>10</sup>: -

- a) Network Capacity – the load that a network can handle at any particular moment
- b) Storage channel – best fitting and access technique – random or sequential
- c) Graphics – graphic operations can differ in actual versus estimates
- d) Computations - Users need to have an indication of systems performance progress

### **4. Disciplines that have greatly contributed to the HCI development**

A number of disciplines have contributed to the development of HCI including the following: -

#### **4.1. Computer Science**

Computer science provides knowledge about technology capabilities and how these can be tapped. These techniques include among others software design, development and maintenance.

#### **4.2. Ergonomics or Human Factors**

---

<sup>9</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 22

<sup>10</sup> Human-computer interaction (3rd ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004). Pg. 22

Ergonomics define and design tools and various artifacts for different work, leisure and domestic environment to suit the capacities and capabilities of users. Ergonomics translate information from sciences into design context with the objective of maximizing operators such as safety, efficiency and performance reliability. These are aimed at making task performance easier and to increasing feelings of comfort and satisfaction.

### **4.3. Cognitive Psychology**

This area is concerned with understanding human behavior and the mental processes underlying it. The most important areas in HCI design are *perception, attention, memory, learning, thinking and problem solving*.

### **4.4. Social and Organization Psychology**

A study of the nature and causes of human behavior in a social context. The four core concerns of psychology are:

- (i) The influence of *one individual* to another person's attitudes and behavior.
- (ii) The impact of a *group* on its member's attitudes and behavior
- (iii) The impact of a *member* on the group's activities.
- (iv) The relationship between the structure and activities of *different groups*.

Social and organizational psychology informs designers about social and organizational structures and the effect of introducing computers into the working practices.

### **4.5. Linguistics**

The scientific study of languages and within HCI, where we need to develop natural language interfaces, it is critical to understand language structure (syntax) and meaning (semantics). Conventional analysis is then used to understand how individuals and groups interact with computers in natural environments.

### **4.6. Artificial Intelligence (AI)**

AI focus is towards the development of intelligent computer programs that simulate intelligent human behavior in form of knowledge structures to solve human problems.

### **4.7. Philosophy, socializing and anthropology**

These disciplines are concerned with the impact of introducing Information Technology to the society, both at individual and political level. This impact contributes towards the moral and ethical aspects of human interactions.

#### **4.8. Engineering and Design**

Engineering is an applied science that utilizes research findings of science to produce objects. Engineering and design contribute to the skills and knowledge put into this production process.

#### **Content Covered in Week 2: Introduction to HCI – The Computer Concept**

- (i) We have defined a computer in connection to Human Computer Interfaces
- (ii) We have described the various devices used to transfer information in computers
- (iii) We have described various disciplines contributing to HCI development

#### **References**

1. Human-computer interaction (3<sup>rd</sup> ed.), Dix, A., Finlay, J., Abowd, G., & Russell, B. New Jersey: Prentice Hall. ISBN-10: 0130461091, ISBN-13: 978-0130461094, (2004).
2. Designing for Effective Human/Computer Interaction (4<sup>th</sup> ed.), Schneiderman, B., Plaisant, C.: Pearson Education, Inc.: ISBN 0-321-19786-0, (2005).
3. The design of everyday things, Norman, D. A. New York: Basic Books. ISBN-10: 0465067107, ISBN-13: 978-046506710, (2002).
4. Designing the user interface: Strategies for effective human-computer interaction (5<sup>th</sup> ed.), Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. New Jersey: Prentice Hall. ISBN-10: 0321537351, ISBN-13: 978-0321537355, (2009).