

UNIT 3: BASIC COMPONENTS OF HUMAN COMPUTER INTERACTION

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1.0 Introduction

The components of Human Computer Interaction comprise the Interaction models that concern translation between the user and the computer system, Ergonomics that describe the physical characteristics of interaction, the Interaction styles that express the nature of user and system dialog and finally the context of the social, organizational and the motivational aspect of interaction. This unit briefly describes each of these components with a desire of giving an overview of the general requirements for the design of human computer interaction systems.

2.0 Objectives

By the end of this unit, you should be able to:

- Understand the Interaction models of interface between the user and system
- Describe the cycle of the execution and evaluation loop
- Explain the concepts of ergonomics
- Know the common interaction styles
- Understand the context of the social, organizational and the motivational aspects of interaction
- The usefulness of the WIMP Interface

3.0 Main Content

3.1 The Interaction Models

The interaction models comprise
The terms of Interaction,

3.1.1 Terms of interaction

Domain: This is the area of work under study e.g. a graphic design

Goal : This is what you want to achieve e.g. to create a solid red triangle

Task : Concerns how you go about doing it, ultimately in terms of operations or actions e.g select the fill tool, click over the triangle

3.1.2 Donald Norman's model:

These are in seven stages as follow:

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

Norman's model concentrates on the user's view of the interface Execution and evaluation loop



Interpretation:

Goal:

The user establishes the goal

Execution:

The user formulates intention

The user specifies actions at interface
The user executes the action

Evaluation:

The user perceives the system state
The user interprets the system state

The user evaluates the system state with respect to goal

Donald Norman's model

Norman's model can be applied through:

Gulf of Execution that evaluates the user's formulation of actions re allowed by the system .

Gulf of Evaluation where the user's expectation of changed system state represent actual presentation of this state
Interaction could harbour some human errors which may be slips

and [mistakes](#).

Slips may include lack of understanding [ing](#) the system and goal, incorrect formulation of action incorrect, action and mistake of not even having the right goal!

To fix slips, better interface design should be carried out while
to avoid mistakes, one should better understand the system

To avoid some of the Human errors, Abowd and Beale framework is adopted. Abowd and Beale framework is an extension of Norman model and it has 4 parts namely:

- i. the user,
- ii. the input,
- iii. the system, and
- iv. the output while each framework has its own unique language.

If interaction is the translation between languages, and if there are problems in iteration, then there would be problems in translation

Using Abowd & Beale's model

The user intentions could be translated into actions at the interface, translated into alterations of state, reflected in the output display system or interpreted by the user himself.

The general framework for understanding interaction are that interaction is not restricted to electronic computer systems alone, all major components involved in interaction should be identified. The comparative assessment of systems should be allowed. The framework also considers an abstraction.

both the physical aspects of interfaces and the industrial interfaces.

Ergonomics

3.2 Ergonomics

This considers is the study of the physical characteristics of interaction. It is known as human factors. Ergonomics is good at defining standards and guidelines for constraining the way we design certain aspects of systems

Examples of Ergonomics include:

Arrangement of controls and displays such as the controls grouped according to function, frequency and sequence of use.

Surrounding environment such as the seating arrangements adaptable to cope with all sizes of user, health issues such as the physical position, environmental conditions (temperature, humidity), lighting, and noise. Use of colour such as the use of red for warning, green for okay, and awareness of colour-blindness etc. The user

. 3 Common Interaction styles

Two major classes of interaction styles will be considered, they are:- Dialogue Style of Interaction between computer and user

Distinct styles of interaction

Both are expressed in the following common forms of interfaces:

- Command line interface
- Menus

- Natural language
- Question and answer, and query dialogue
- Form-fills and spreadsheets
- WIMP
- Point and click
- Three—dimensional interfaces

3.3.1 Command line interface

This is the way of expressing instructions to the computer directly through the function keys, single characters, short abbreviations, whole words, or a combination suitable for repetitive tasks.

The interface is better designed for expert users than novices because it offers direct access to system functionality. However, the command names and abbreviations used should be meaningful!

A typical example is the Unix system command line interface.

3.3.2 Menus

Menus is a set of options displayed on the screen. The Menu Options are visible, it has a less recall characteristic that make it easier to use.

The visible options rely on recognition so the names should be meaningful. The selection is done through numbers, letters, arrow keys, mouse and/or combination of any of them e.g. mouse plus accelerators

.Often, the options are hierarchically grouped. But sensible grouping is needed. Menus are restricted form of full WIMP system .

3.3.3 Natural language

This is the language familiar to the user. It may be in form of speech recognition or a typed natural language.

Problems with in this kind of interaction are that the language may be vague, ambiguous, and hard to be recognised.

Design solutions to language interface problems are for the user to try to understand a subset and pick on key words .

3. 3.4 Query interfaces

These comprise question and answer interfaces in which the user is led through interaction via series of questions. Though with restricted functionality, this kind of interface is suitable for novice users. It is often used in information systems.

Query languages (e.g. SQL)

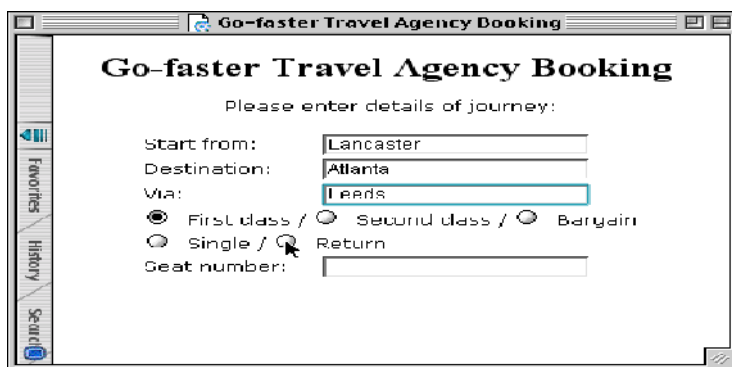
This is used to retrieve information from database. It requires understanding of the database structure and language syntax, hence requires some expertise

3. 3.5 Form-fills and Spreadsheets

Form-fills are primarily designed for data entry or data retrieval. It is a screen like paper form to which data is put in relevant place.

It requires a good design and obvious correction facilities.

See illustration below



Example of a form-fill

Spreadsheets

Spreadsheets are sophisticated variations of form-filling in which grid of cells contain a value or a formula. The formula can involve values of other cells e.g. sum of all cells in this column.

The user can enter and alter data in spreadsheet to maintain consistency.

The first spreadsheet introduced was VISICALC, followed by Lotus 1-2-3. Micro Soft Excel is the most common today

3. 3.6 WIMP Interface

This interface comprises Windows, Icons, Menus, and Pointers or Windows, Icons, Mice, and Pull-down menus!

The interface is the default style for majority of interactive computer systems, especially PCs and desktop machines.

Elements of the WIMP interface

The elements include windows, icons, menus, and pointers. In some other cases they may be buttons, toolbars, palettes, and dialog boxes.

Understanding the concept of 'Look and feel'

WIMP systems have the same elements: as windows, icons., menus, pointers, buttons, etc. but have different window systems that *behave* differently . For example, Macintosh Operating System (MacOS) compared with Windows menus.

The combination of the appearance and the behaviour is the 'look and feel'

Windows

Windows are areas of the screen that behave as if they were independent. They can contain text or graphics and can be moved or resized.

They can overlap and obscure each other, or can be laid out next to one another (tiled)

Icons

Icons are small pictures or images that represent some object in the interface. They appear often as windows or as actions.

Windows can be 'iconised' that is closed down. They are small representations that fit many accessible windows.

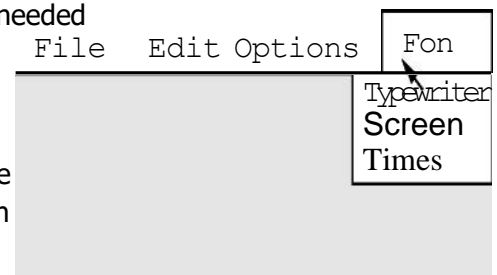
Icons can be many and various. They can be highly stylized with realistic representations.

Menus

These are choice of operations or services offered on the screen

The required option is selected with the pointer. However, this takes a lot of screen space

This problem is partly solved when a pop-up menu appears when needed



Kinds of Menus

Menu Bar at top of screen (normally), menu drags down

- i. Pull-down menu - mouse hold and drag down menu
- ii. Drop-down menu - mouse click reveals menu
- i. Fall-down menus - mouse just moves over bar!

Contextual menu appears where you are

Pop-up menus take actions for selected object

Pie menus are arranged in a circle such that it is easier to select item over larger target area. Selection is also quicker because it can move same distance to any option. Pie menus are not widely used!

Cascading menus

This has a hierarchical menu structure in which a menu selection opens new menu and so in ad infinitum

Keyboard accelerators

This comprises key combinations with same effect as menu item.

They operate in two modes

- active when menu open — usually first letter and
- active when menu closed — usually Ctrl + letter

Menus design issues

In order to design an effective menu, the following issues should be considered:

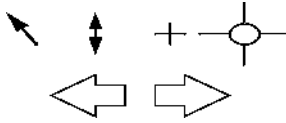
- which kind to use
- what to include in menus at all
- words to use (in action or description)
- how to group items
- choice of keyboard accelerators

Palettes and tear-off menus

- Palettes are little windows of actions shown or hidden via menu option in available shapes in drawing package
- In tear-off and pin-up menus, menu 'tears off' to become palette

Pointers

Pointers are important WIMP style components that point on and select. They are activated by the use of mouse, track pad, joystick, trackball, cursor keys or keyboard shortcuts. They are in wide variety of graphical images. See examples below.



Point and click interfaces

Point and click interfaces are used in multimedia, web browsers, and hypertext. You just click something such as icons, text links or location on map. It requires minimal typing.

Scrollbars

Scrollbars allow the user to move the contents of the window up and down or from side to side.

Title bars

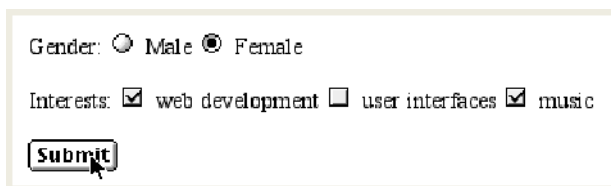
Title bars describe the name of the window

Buttons

This is an individual and isolated region within a display that can be selected to invoke an action

The Special kinds that exist are

The radio buttons with a set of mutually exclusive choices and the check boxes with a set of non-exclusive choices.



Toolbars

These are long lines of icons with fast access to common actions and are often customizable:

You can choose *which* toolbars to see and choose *what* options are on it

Dialogue boxes

These are information windows that pop up to inform of an important event or requested information, for example when saving a file, a dialogue box is displayed to allow the user to specify the filename and location. Once the file is saved, the box disappears.

The interactivity of dialogue boxes

They are easy to focus on look and feel.

Other types of interaction styles are speech—driven interfaces

The development of this kind of interface is yet to be perfect and accurate; though it is rapidly improving.

Example of speech driven interface dialogue on an airline reservation:

reliable "yes" and "no"?

+ System reflects back its understanding

"you want a ticket from New York to Boston?"

3. 3.7 Three dimensional interfaces

These are virtual reality 'ordinary' window systems highlighting visual affordance. The indiscriminate use can however be confusing!

There are also three dimensional (3D) workspaces used for extra virtual space with light and occlusion that give deep distance effects.

For typical computer displays, three-dimensional images are projected on them in two dimensions. Three-dimensional graphics are currently mostly used in computer games, art and computer-aided design (CAD). There have been several attempts at making three-dimensional desktop environments like Sun's Project Looking Glass. A three-dimensional computing environment could be used for collaborative work. For example, scientists could study three-dimensional models of molecules in a virtual reality environment, or engineers could work on assembling a three-dimensional model of an airplane.] The Technologies The use of three-dimensional graphics has become increasingly common in mainstream operating systems, but mainly been confined to creating attractive interfaces—eye candy—rather than for functional purposes only possible using three dimensions. For example, user switching is represented by rotating a cube whose faces are each user's workspace, and window management is represented in the form of Exposé on Mac OS X. In both cases, the operating system transforms windows on-the-fly while continuing to update the content of those windows.

Interfaces for the X Window System have also implemented advanced three-dimensional user interfaces through compositing window managers such as Beryl and Compiz using the AIGLX or XGL architectures, allowing for the usage of OpenGL to animate the user's interactions with the desktop.

Another branch in the three-dimensional desktop environment is the three-dimensional GUIs that take the desktop metaphor a step further, like the BumpTop, where a user can manipulate documents and windows as if they were "real world" documents, with realistic movement and physics.

The Zooming User Interface (ZUI) is a related technology that promises to deliver the representation benefits of 3D environments without their usability drawbacks of orientation problems and hidden objects. It is a logical advancement on the GUI, blending some three-dimensional movement with two-dimensional or "2.5D" vector objects.

3.4 Context: Social and Organisational

These issues and concerns involve all possible interactions between a user and a system during its lifecycle, including the development stage, use in context, and the impact of such use on individuals, organizations, society, and future systems development.

Context Analysis

Context analysis includes understanding the technical, environmental and social settings where the information systems will be used. It examines whether and how the interaction between physical and social environment and the physiological and psychological characteristics of the user would impact users interacting with the system.

There are four aspects in Context Analysis: physical context, technical context, organizational context, and social and cultural context. Overall, context analysis can provide ideas for design factors such as metaphor creation, selection and patterns of communications between users and the system.

Physical context: This considers where the tasks carried out, what entities and resources are implicated in task operation, What physical structures and entities are necessary to understand observed task action. For example, an ATM machine can be used in a mall outside a bank office, or in a night club. These environments provide different levels of lighting, crowdedness, and noisiness. Thus legibility of the screen, use of audible devices

for input or output, or even the size of the working space to prevent people nearly to see the screen could be designed differently.

Technical context: This considers the technology infrastructure, platforms, hardware and system software, wired or wireless network connection? For example, an E-commerce website may be designed to allow access only to people with certain browser versions. The website may also be designed to allow small screen devices such as PDA or mobile phone to access.

Organizational context: Organizational context may play different roles in internal and external situations. For an organizational information system to be used by the organization's own employees, organizational context analysis answers questions such as:

- What is the larger system where this information system is embedded?,
- What are the interactions with other entities in the organization?
- What are the organizational policies or practice that may affect individual's attitude and behavior towards using the system?

For example, assuming that Lotus Note is used by an organization as a communication and collaboration tool, management may depend on using the tool to set up meetings by checking employees' calendars on mutually available time slots. The effectiveness of setting up meetings depends on whether employees use the tool, and how they use it. The whether and how questions can be enforced by organizational policies.

Social and cultural context: What are the social or cultural factors that may affect user attitudes and eventual use of the information system? In an E-Commerce website example, the website can be accessed from all over the world. It thus is a design consideration that the website allows access by people with any language and cultural background that can provide credit cards with the foreign currency exchange, or it is only accessible to people who speak certain languages and are from certain cultures.

Interactions are also affected by other social and organizational context as follow:

- By other people: A desire to impress, competition among stakeholders, and fear of failure from management
- Motivation from management as against fear, allegiance, ambition, self-satisfaction that exist among employees
- Existing inadequate systems that may cause frustration and lack of motivation

The organizational, social and cultural context in which humans interact with IT is largely the result of the broad adoption of IT by organizations and society to support organizational functions and goals and to enhance society's development. For example, organizational efficiency may be expected due to redesign of workflows among critical business units that is affected by the implemented IT; satisfaction and retention of customers/clients are anticipated

due to accurate and fast information gathering and presentations, to name a few. Some of the organizational or societal impacts may not be tangible or directly attributed to HCI considerations.

This assertion is in line with the issues of determining IT values in organizations and societies.

While each of these HCI concerns may have its own importance in different situations in relation to human motivation, it would be helpful for designers to see an overview picture of the potential HCI concerns and goals. The purpose of this picture is not to force every IT to be compliant with all the HCI concerns, but to provide an overall framework so that designers can use it as a roadmap and to apply it according to different situations.

4.0 Conclusion

The knowledge of the basic components of human computer interaction aids in giving direction, focus and human considerations pertaining to interactive design.

5.0 Summary

There are variations of interaction models of the interface established between the user and the computer system. These models are presented as a loop in the execution and evaluation of an interactive design. These interaction models together with the human ergonomics, the interaction styles, and the social and organizational contexts are basic components of human computer interaction.

6.0 Tutor Marked Assignment

1. Explain the three terms of Interaction
2. Mention any 4 of the 7 stages of the Donald Normans model and briefly describe each of the stages.
3. What do you understand as the execution and evaluation loop and how is the loop useful in the user's participation in the design of interactive systems
4. What are slips and mistakes in human Computer interaction and how do you avoid such slips and mistakes before they occur?
5. Briefly express your understanding of the term Ergonomics
6. Describe any four common interaction styles
7. What are Cascading menus and Keyboard accelerators?
8. What are the four constituent aspects of Context analysis? How are they of benefits to the user interacting with the computer system?

7.0 Further Readings / References

- Licklider, J.C.R. and Taylor, R.W., "The computer as Communication Device." *Sci. Tech.*, 1968. April: pp. 21- 31.
- Linton, M.A., Vlissides, J.M., and Calder, P.R., "Composing user interfaces with InterViews." *IEEE Computer*, 1989. 22(2): pp. 8-22.
- Meyrowitz, N. and Van Dam, A., "Interactive Editing Systems: Part 1 and 2." *ACM Computing Surveys*, 1982. 14(3): pp. 321- 352.
- Myers, B.A., "The User Interface for Sapphire." *IEEE Computer Graphics and Applications*, 1984. 4(12): pp. 1 3-2 3.
- Myers, B.A., "A Taxonomy of User Interfaces for Window Managers." *IEEE Computer Graphics and Applications*, 1988. 8(5): pp. 65-84.