Human Computer Interaction

MCA-307
(Elective 5.2.2)
MCA –V Sem.

Course Objective

- *The main objective is to perform analysis, establish requirements, design and evaluate interactive computer-based systems and products. It will discuss about the human cognition and human perspective by working with computers. Designing interactive computer systems to be efficient, easy, and enjoyable to use is important. The course will cover a broad knowledge regarding the human-friendly interface design.*

Unit 1

Human-Computer Interaction

- Human-computer interaction (HCI) is a multidisciplinary field of study focusing on the design of computer technology and, in particular, the interaction between humans (the users) and computers. While initially concerned with computers, HCI has since expanded to cover almost all forms of information technology design.

- Human-computer interaction (HCI) is the study of ***how people interact with computing technology.***
- HCI study is the region of intersection between **psychology** and the social sciences, on the one hand, and computer science and **technology**, on the other.

- Human-Computer <u>interface.</u>
  - Where people “meet” or come together with machines or computer-based systems.
  - ‘Physical interface’ (e.g. buttons, screens, menus, etc.)
  - ‘Logical interface’.
    - The **model** a system presents a user.
    - Set of **tasks** available and how they’re organized.

Idea of Human-Computer Interaction

- A key design activity is to design the **user-interface**.
- For every input and output the developer must consider the **interaction between the user and the computer**.
- Because the interaction is much like a dialog between the user and the computer, user-interface design is often referred to as '**dialog design**'.

- The field of HCI investigates how people **use** computer systems, so that better systems can be designed.
- One aspect is concerned with **technological innovation** (e.g. better input devices, like electronic pen etc.)
- The other aspect is concerned with the **human element** (e.g. how people reason, solve problems and interact with computers)

- There are many ways in which computers humans' interaction performed, and the boundary between the computers and humans used is essential in the facilitation of this interaction. Internet browsers, desktop applications, computer kiosks and handheld computers utilize the existing graphical user interfaces that are available today. On the other hand, voice user interfaces are commonly used for synthesizing systems and speech recognition and the newly developed gestalt user interfaces and multi-modal interfaces that allow a person to interact with personified character agents in ways that can never be achieved with any other paradigm.

- Human computer interaction is defined as a field related with the evaluation, design and execution of interactive computing systems incorporated with the study of major paradigms surrounding them. One of the most important aspects of human computer interaction is securing the end user computer satisfaction. On the computer side, practices in operating systems, computer graphics, development environments and programming languages are relevant. Additionally, on the human facet industrial design principles, communication theory, graphic design disciplines, social sciences, social psychology and cognitive psychology. Design and engineering techniques are also relevant.

Cognitive psychology

- **Cognitive psychology** is the scientific study of mental processes such as "attention, language use, memory, perception, problem solving, creativity, and thinking".
- Cognitive psychology focuses on the way people process information.
- **Cognitive psychology** is the branch of psychology that focuses on the way people process information. It looks at how we process information we receive and how the treatment of this information leads to our responses. In other words, cognitive psychology is interested in what is happening within our minds that links **stimulus** (input) and **response** (output).

Cognitive psychologists study internal processes that include perception (the way in which something is understood, or interpreted.), attention, language, memory, and thinking. They ask questions like:

- How do we receive information about the outside world?
- How do we store and process information?
- How do we solve problems?
- How does a breakdown in our perceptions cause errors in our thinking?
- How do errors in our thinking lead to emotional distress and negative behaviors?

The Goals Of Human Computer Interaction

The goal of human computer interaction is to bring forth safe and usable systems that function effectively. To develop computer systems with perfect usability, the developers must try to:

- Put the users first
- Achieve effective, efficient and safe interaction
- Develop techniques and tools to allow the development of suitable computer systems
- Understand all the factors that contribute to how people use technology in their day to day lives

The most important thing is that people using the system should come first.

Factors In Human Computer Interaction (HCI)

- In the design and analysis of any system that uses Human computer interaction principles there are many factors that must be considered. Most of these HCI factors often interact with one another, and this makes the analysis more complicated. **These Factors Include :-**
- **Organizational Factors**
  These include work organization, training, roles, job design and politics
- **Task Factors**
  Skills, monitoring, task allocation, complex, novel, easy
- **Environmental Factors**
  Ventilation health, safety, heating and lighting

- **Comfort Factors**
  Layout, seating, equipment
- **The User**
  Cognitive capabilities and processes
  Enjoyment, experience, satisfaction, personality, motivation
- **System Functionality**
  Hardware, software, application
- **Productivity factors**
  Increase quality, increase innovation, increase output, decrease errors and decrease costs.

Disciplines Contributing To Human Computer Interaction (HCI)

- The Human computer interaction field covers an extensive range of topics and its progression is dependent on a number of disciplines. Disciplines that have contributed significantly to the growth of human computer interaction include:-
- **Cognitive psychology**

  Limitations, information processing, performance prediction, cooperative working and capabilities
- **Computer science**

  Including graphics, technology, prototyping tools, user interface management systems

- **Linguistics**

  Including natural language interfaces
- **Engineering and design**

  Engineering principles

  Graphic design
- **Artificial intelligence**

  Intelligent software
- **Human factors**

  Display readability

  Hardware design

There are five main types of user interface:

- command line (cli)
- graphical user interface (GUI)
- menu driven (mdi)
- form based (fbi)
- natural language (nli)

Command Line Interface

Command line interfaces are the oldest of the interfaces discussed here. It involves the computer responding to commands typed by the operator. This type of interface has the drawback that it requires the operator to remember a range of different commands and is not ideal for novice users.

Graphical user interfaces (GUI) are sometimes also referred to as WIMP because they use *Windows*, *Icons*, *Menus* and *Pointers*. Operators use a pointing device (such as a mouse, touchpad or trackball) to control a pointer on the screen which then interacts with other on-screen elements. It allows the user to interact with devices through graphical icons and visual indicators such as secondary notations.

- **Menu Driven**

  A menu driven interface is commonly used on cash machines (also known as automated teller machines (ATM's), ticket machines and information kiosks (for example in a museum). They provide a simple and easy to use interface comprised of a series of menus and sub-menus which the user accesses by pressing buttons, often on a touch-screen device. Preferably, if one has knowledge on UML modeling, it can be a good example when designing the architecture of the machine.

- **Form Based**

  A form-based interface uses text-boxes, drop-down menus, text areas, check boxes, radio boxes and buttons to create an electronic form which a user completes in order to enter data into a system. This is commonly used on websites to gather data from a user, or in call centres to allow operators to quickly enter information gathered over the phone.

- **Natural language**

  A natural language interface is a spoken interface where the user interacts with the computer by talking to it. Sometimes referred to as a 'conversational interface', this interface simulates having a conversation with a computer. Made famous by science fiction (such as in Star Trek), natural language systems are not yet advanced enough to be in wide-spread use. Commonly used by telephone systems as an alternative to the user pressing numbered buttons the user can speak their responses instead. An Example of this type of interface is Voice Recognition

Human-Computer Interaction Frameworks

- Human-Computer Interaction (HCI) Frameworks are models that provide guidance for health informaticists to complete user-centered design processes, usability tests, IT adoption evaluations, and usability research.
- Recently many models and frameworks have been produced to define the interactions between users and computer/technology.
- Some of these HCI frameworks are the UFuRT (User, Function, Representation, and Task analysis) framework , FITT (Fit between Individuals, Task, and Technology) framework , HOT-fit (Human, Organization, Technology-fit) framework and the Staggers Human-Computer Interaction Framework.

Architecture of HCI systems

- Most important factor of a HCI design is its configuration. In fact, any given interface is generally defined by the number and diversity of inputs and outputs it provides. Architecture of a HCI system shows what these inputs and outputs are and how they work together.
- Now we will explain different configurations and designs upon which an interface is based.

Unimodal HCI Systems

- An interface mainly relies on number and diversity of its inputs and outputs which are communication channels that enable users to interact with computer via this interface. Each of the different independent single channels is called a modality. A system that is based on only one modality is called unimodal.
- Based on the nature of different modalities, they can be divided into three categories:
- 1. Visual-Based
- 2. Audio-Based
- 3. Sensor-Based

Visual-Based HCI

- The visual based human computer interaction is probably the most widespread area in HCI.

Some of the main research areas in this section are as follow: -

- Facial Expression Analysis
- Body Movement Tracking (Large-scale)
- Gesture Recognition
- Gaze Detection (Eyes Movement Tracking)

- Facial expression analysis generally deals with recognition of emotions visually
- Body movement tracking and gesture recognition are usually the main focus of this area and can have different purposes but they are mostly used for direct interaction of human and computer in a command and action scenario.
- Gaze detection is mostly an indirect form of interaction between user and machine which is mostly used for better understanding of user’s attention, intent or focus in context-sensitive situations

Audio-Based HCI

- The audio based interaction between a computer and a human is another important area of HCI systems. This area deals with information acquired by different audio signals. While the nature of audio signals may not be as variable as visual signals but the information gathered from audio signals can be more trustable, helpful, and is some cases unique providers of information.
- Research areas in this section can be divided to the following parts: • Speech Recognition • Speaker Recognition • Auditory Emotion Analysis • Human-Made Noise/Sign Detections (Gasp, Sigh, Laugh, Cry, etc.) • Musical Interaction

Sensor-Based HCI

- This field is a combination of variety of areas with a wide range of applications. The commonality of these different areas is that at least one physical sensor is used between user and machine to provide the interaction. These sensors as shown below can be very primitive or very sophisticated. 1. Pen-Based Interaction 2. Mouse & Keyboard 3. Joysticks 4. Motion Tracking Sensors and Digitizers 5. Haptic Sensors 6. Pressure Sensors

- Pen-Based sensors are specifically of interest in mobile devices and are related to pen gesture and handwriting recognition areas.
- Motion tracking sensors/digitizers are state-of-the-art technology which revolutionized movie, animation, art, and video-game industry. They come in the form of wearable cloth or joint sensors and made computers much more able to interact with reality and human able to create their world virtually.
- Haptic and pressure sensors are of special interest for applications in robotics and virtual reality

Multimodal HCI Systems

- Multimodal human-computer interaction refers to the "interaction with the virtual and physical environment through natural modes of communication", This implies that multimodal interaction enables a more free and natural communication, interfacing users with automated systems in both input and output. Specifically, multimodal systems can offer a flexible, efficient and usable environment allowing users to interact through input modalities, such as speech, handwriting, hand gesture and gaze, and to receive information by the system through output modalities, such as speech synthesis, smart graphics and other modalities, opportunely combined. Then a multimodal system has to recognize the inputs from the different modalities combining them according to temporal and contextual constraints in order to allow their interpretation.

References

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