## Module Code
## COU 07507

## Module Name:

## Human Computer Interface and Interactive Devices Design

## Number of Credits:6

# What is HCI?

Human-computer interaction (HCI) is an interdisciplinary field combining insights from psychology, computer science, and design.

It seeks to enhance our understanding of the complex relationship between humans and the digital world by studying:

- How people use digital technologies

- How innovators can design technologies to better meet users' needs

- How they impact our behavior and well-being

As technology evolves, it's increasingly important to understand how humans interact with digital systems to create effective, user-friendly [products](#) and services.

HCI encompasses various topics, including:

. <u>User interface (UI) design</u>

. <u>User experience (UX)</u>

. <u>Usability testing</u>

. Human factors engineering

HCI draws on various disciplines to develop theories and methods that help researchers and practitioners understand the complex interactions between humans and technology.

# The rise of HCI

➢ The roots of human-computer interaction (HCI) lie in the early days of computing. Researchers and practitioners began exploring how people could interact with computers beyond punch cards and paper tape.

➢ In the 1960s and 1970s, the emergence of graphical user interfaces (GUIs) revolutionized how people interacted with computers. This enabled them to use a mouse and keyboard to navigate digital interfaces.

➢ The creation of GUIs led to a growing interest in how people interacted with computers and the development of new tools and methods for studying human-computer interactions.

➢ One key HCI pioneer was Douglas Engelbart. He developed the first computer mouse in the 1960s before developing other key innovations, such as hypertext and networked computing.

➢ Engelbart believed humans could use computers to augment human intelligence, and he saw the study of human-computer interaction as a critical component of this vision.

➢ Another significant figure in the field was Ben Shneiderman. He introduced the concept of "direct manipulation" in user interfaces and developed the widely used *treemap*.

➢ With the rise of mobile computing, the Internet of Things, and virtual and augmented reality, studying HCI has become more critical than ever.

# Why is HCI important?

Human-computer interaction is an essential aspect of modern technology, influencing the design and development of digital systems and applications in almost every sector.

## HCI in daily lives

With the widespread use of computers and digital devices, HCI is essential to our daily lives. Whether we use our smartphones, tablets, laptops, or desktop computers, we interact with technology somehow. HCI ensures these interactions are accessible, efficient, and enjoyable.

# Industry

HCI helps companies create products and services that meet the needs of their customers. Companies can design more user-friendly, intuitive, and efficient products by understanding how people interact with technology. This approach can increase [customer satisfaction](), sales, and profits.

# Accessibility

HCI makes technology accessible to people with disabilities. We can bridge the digital divide and provide equal access to information and technology by designing interfaces that are easy to use for people with visual, auditory, or motor disabilities.

# An integral part of software success

A poorly designed interface can lead to frustration, user errors, and low adoption rates. On the other hand, a well-designed interface can enhance user satisfaction, increase productivity, and improve overall performance.

# Useful for untrained communities

HCI is important in making technology accessible to untrained communities. By designing intuitive and easy-to-use interfaces, we can provide equal access to technology for people who may not have extensive computer experience.

By prioritizing HCI, we can create technologies that are more user-friendly, accessible, and effective, improving people's experiences and enhancing their quality of life.

# Principles of HCI

Several principles of human-computer interaction (HCI) guide the design and development of user-friendly interfaces and systems:

- **Mapping**: Mapping refers to the connection between user input (controls) and system output (actions). It should be easy to understand and intuitive for users.

- **Consistency**: In design, consistency ensures similar actions and elements have homogenous representations throughout the interface. This reduces the need for users to learn and memorize new interactions.

- **Simplify**: The system should be simple and avoid unnecessary complexity that could compromise the user experience.

- **Feedback**: Feedback is essential to communicate to the user whether or not their actions have been successful. It could be in the form of visual, auditory, or haptic feedback.

# Principles of HCI cont…

- **Visibility**: This refers to the ability of the user to see and understand the state of the system and its components, making it easier for them to take appropriate actions.

- **Constraints**: The design should use physical or logical limitations to prevent users from taking certain actions or making mistakes.

- **Mental Models**: The design should align with the user's mental model of how the system should work, facilitating ease of use and understanding.

- **Affordance**: The system should provide affordances, or clues, about possible actions and how to perform them.

- **Learnability**: The system should be easy to learn and use, with minimal need for extensive training or documentation.

- **Error prevention and recovery**: Interfaces should prevent errors and allow users to recover from errors easily and quickly.

# Key components of HCI

Human-computer interaction is a multidisciplinary field encompassing various components:

- **Input devices**

Input devices interact with the computer. This includes keyboards, mice, touchscreens, voice recognition systems, and gesture-based systems. They enable users to provide input to the computer and control the system.

- **Output devices**

These devices provide feedback to the user, including monitors, speakers, printers, and haptic devices. They enable the computer to provide visual, auditory, or tactile feedback, allowing the user to understand the results of their actions.

# Key components of HCI cont..

- **User interface**

The user interface (UI) is part of the system allowing users to interact with the computer. It includes graphical user interfaces (GUIs), command-line interfaces (CLIs), and natural language interfaces. The UI should be intuitive, easy to use, and efficient, enabling users to achieve their goals quickly and easily.

- **Interaction design**

This design shows how users interact with the computer. It involves designing the user interface, selecting appropriate input and output devices, and designing how the computer responds to user input.

- **Usability testing**

Usability testing asks real users to evaluate a system. It involves tasks such as observing users interact with the system, collecting feedback, and identifying areas for improvement.

# Key components of HCI cont..

**Accessibility**

• Accessibility includes designing interfaces that everyone can use, regardless of their physical ability.

**Human factors**

• This studies how humans interact with technology. It includes factors such as cognitive load, attention, perception, and memory, and it seeks to understand how these factors influence HCI system design.

## Examples of HCI

HCI is a broad, multidisciplinary field, including various domains and technologies. We can find the application of HCI principles in almost every aspect of our lives, including:

. Our interactions with smartphones and computers

. The design of complex systems in healthcare, transportation, and industrial control

# 1. Internet of Things (IoT) Technology

These systems integrate physical devices, such as sensors, actuators, and other smart devices, with digital systems, enabling them to communicate with each other and users.

The design of IoT systems involves HCI principles, ensuring users can easily interact with, control, and monitor the devices effectively.

For example, the design of a smart home system would involve considerations such as:

- The placement and usability of sensors

- The design of the user interface

- The integration of voice or gesture-based controls

By applying HCI principles to IoT systems, designers can create intuitive, user-friendly interfaces.

# 2. Eye-tracking technology

This technology uses specialized cameras and software to monitor and analyze eye movements. Designers and researchers can use the technology to understand how users interact with interfaces, including websites, software, and physical devices.

By analyzing eye movements, researchers can identify:

- Which parts of the interface users are paying attention to

- How long they spend on each element

- Where they experience difficulties

Various settings use eye-tracking technology, including:

- Market research: Analyzing consumer behavior and preferences by seeing how they interact with advertisements and products

- Usability testing: Evaluating the effectiveness of user interfaces by measuring how easily users can find information and complete tasks

- Medical research: Studying eye movements in people with neurological or developmental disorders for accurate diagnosis

The technology must be comfortable and non-invasive for users, and the data must be simple for researchers to analyze and interpret.

# 3. Speech recognition technology

- This technology uses software that can recognize and interpret human speech. It enables users to interact with devices and systems using natural language, such as giving commands or dictating text.

- Speech recognition technology is applicable in different fields, like virtual assistance. It enables users to interact with devices using voice commands, making accessing information and controlling functions easier.

- Speech recognition in hands-free control in cars and home automation systems enables users to operate the devices without using their hands, increasing safety and convenience.

- For people with disabilities, speech recognition technology can provide an alternative input method. This enables them to use computers and other devices even if they cannot use traditional input devices such as keyboards and mice.

- Speech recognition technology should discern different accents and languages and understand natural language, including idioms and colloquialisms.

# 5. Cloud computing

Cloud computing is the interaction between a human and computer system to access resources and services over the internet.

Cloud computing allows users to access computing resources, such as:

- Processing power
- Storage
- Software applications from remote servers located in data centers

Users can interact with these resources through web browsers, mobile apps, or dedicated client applications.

# Future scope of HCI

The human-computer interaction (HCI) field is continuously evolving, and its future is promising.

Here are some areas where HCI is likely to make significant advancements in the coming years:

- **Augmented and virtual reality**: As AR and VR technologies advance, HCI research will create more natural and immersive interfaces to enhance the user experience.

- **Wearable computing:** With the rise of wearable devices like smartwatches and health trackers, HCI will develop new interaction techniques and optimize interfaces.

- **Internet of Things (IoT):** As IoT devices become more prevalent, HCI research will focus on designing interfaces and interaction techniques, enabling users to easily control and interact with connected devices.

- **Artificial intelligence (AI):** With AI technology advances, HCI research will develop interaction techniques, ensuring users can communicate effectively and collaborate with intelligent systems.

- **Accessibility**: HCI research will continue to focus on developing more accessible interfaces and interaction techniques for users with disabilities, enabling them to interact with technology more effectively.

# Questions

1. What is the difference between human-computer interaction and human-centered computing?

2. How are ergonomic factors contributing to human-computer interaction?

3. What is the difference between human-computer interaction and interaction design?