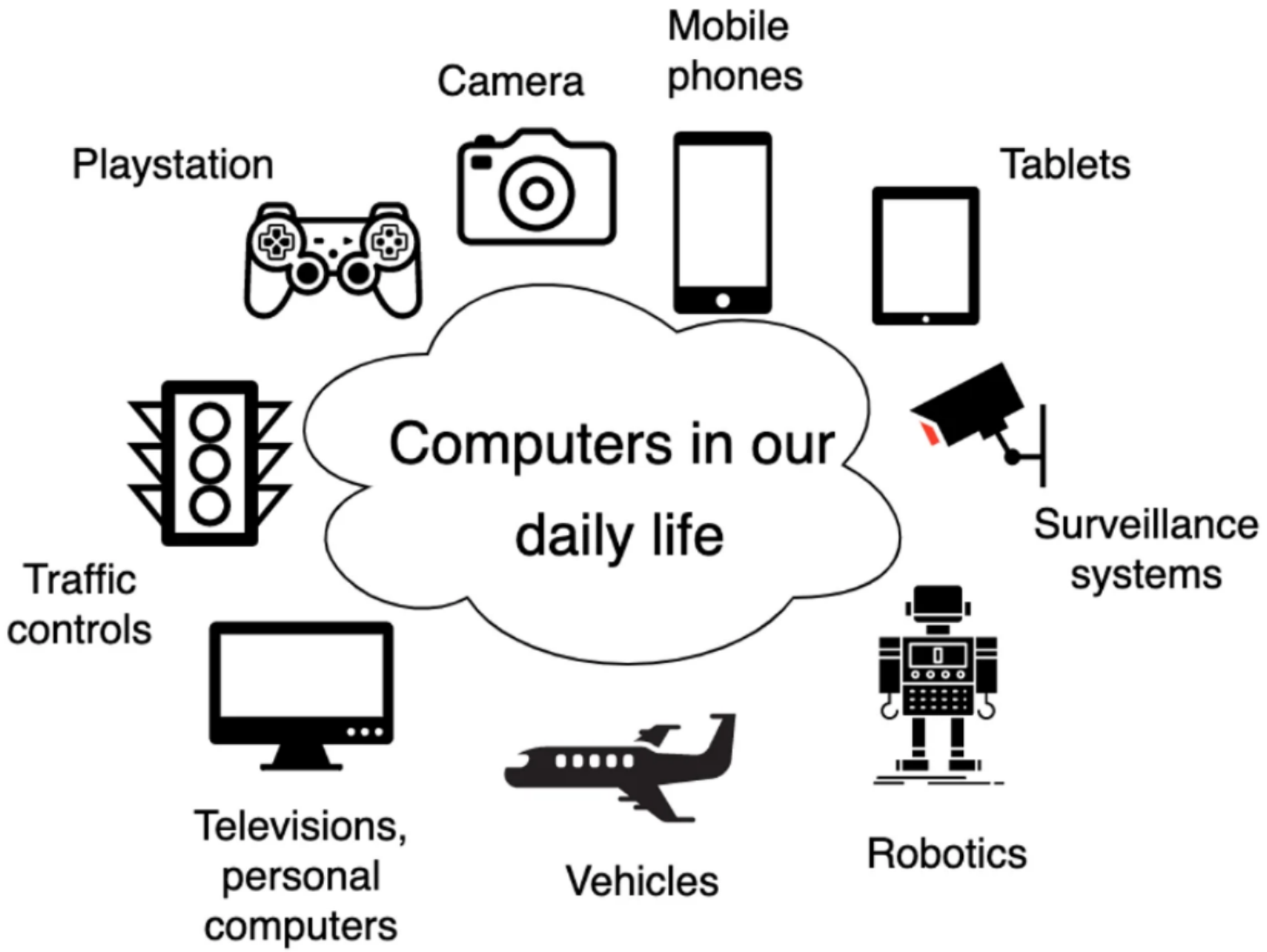
Human-Computer Interaction & Design Principles

HCI has **always been a part of technology and design**, but it is **on the rise as technology becomes more integrated with our daily lives**. HCI is a **vital skill for any developer, product manager, or designer who wants to design for the future**.

HCI helps to make interfaces that **increase productivity**, **enhance user experience**, and **reduce risks** in **safety-critical systems**. Poorly designed machines lead to many **unexpected problems, sometimes just user frustration, but sometimes, chaotic disasters**.

This is why HCI is on the rise. As we become **more dependent on technologies, even just the Internet or smartphones**, HCI has become a **key part of designing tools that can be used efficiently and safely on a daily basis**.


Mobile phones
Camera
Playstation
Tablets
Computers in our daily life
Surveillance systems
Traffic controls
Televisions, personal computers
Vehicles
Robotics

Research applications in this field focus on:

How to design improved computer interfaces that are optimized for particular qualities, such as learnability, findability, and usability.

How to evaluate and compare different interfaces in terms of their usability

How to determine if a user is human or computer

How to study the sociocultural implications of human-computer interactions

In order to build effective interfaces, we need to first understand the limitations and capabilities of both components. Humans and computers have different input-output channels.

Humans:

- Long-term memory
- Short-term memory
- Sensory memory
- Visual perception
- Auditory perception
- Tactile perception
- Speech and voice

Computers:

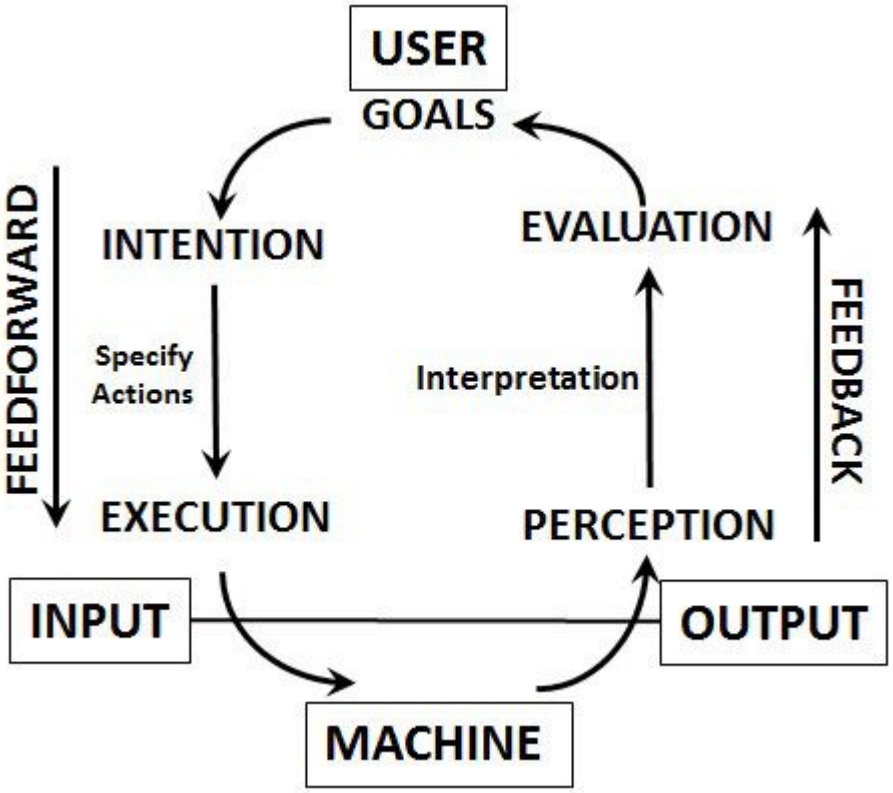
- Text input devices
- Speech recognition
- Mouse / touchpad / keyboard
- Eye-tracking
- Display screens
- Auditory displays
- Printing abilities

Norman's model of interaction

Norman's model of interaction (sometimes called the execution-evaluation cycle) a notable model for HCI. It proposes that a user first establishes a **goal** and then **performs actions using the system to achieve that goal**.

A system **then reflects the output of those actions on the interface**. A **user observes the interface and evaluates if their goal has been met**. If not, **a new goal is established, and the cycle is repeated**.

1. Establish the goal
2. Formulate the intention
3. Specify actions
4. Execute actions
5. Perceive system state
6. Interpret system state
7. Evaluate system state



Execution: There is a difference between user actions and those that the system can perform. An effective interface allows a user to perform an action without system limitations.

Evaluation: There is a difference between the presentation of an output and the user's expectations. An effective interface can be easily evaluated by a user.

Human error: The system is performing correctly, but the user has inputted an error. Errors can be avoided by improving interface design or providing better user support.

Ergonomics of Interaction

Another key component of HCI is ergonomics. **Once we understand how a computer and user interact via an interface**, we need to better understand **how to enhance user performance**. There are many ergonomical factors that come into play when designing a system:

Controls and display: Display sections and controls should be grouped logically **according to human perception**. The logic of arrangement **depends on the application and the domain, such as by sequence, function, or frequency.**

Colors: Since humans are limited by visual perception, **it's key to design color properly**. Colors should **always be distinct, and the distinction of colors should remain unaffected by changing contrast**. Common color conventions should also be used (**for example, red for a warning and green for success**).

Design Process Steps :

There are three general steps to follow for interaction design. Let’s examine each in detail.

1. **User research and requirements analysis**

Before designing, we **must know about our users and what problems they have that we can solve with our system**. Any technology we want to build **will have a specific context that should guide the design process**.

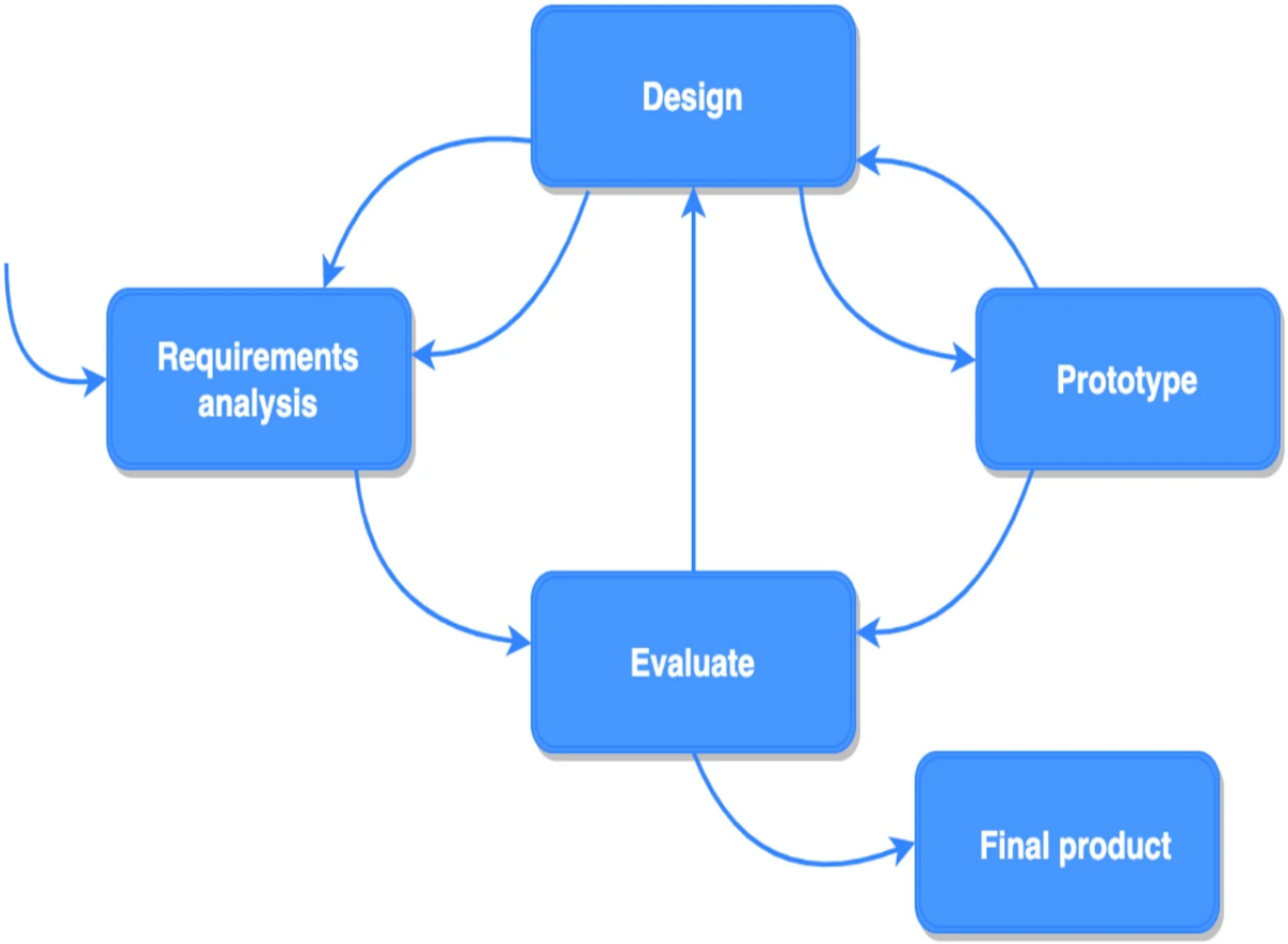
For example, will the interface be used in a safety-critical system?

2. Designs and prototyping

The second step involves **creating the designs and prototyping**. We are **essentially converting our requirements into possible solutions**. This will include **both conceptual design (how will a system perform) and physical design (colors, interaction styles).** Then we prototype our different design ideas.

3. Evaluating the designs

Once the **final product has been built, we must evaluate this design**. Both **experts and actual users should be evaluators to test that it meets requirements and HCI design principles**. From there, we can **tweak and design and make improvement alterations**.


Design
Requirements analysis
Prototype
Evaluate
Final product

HCI Design Rules and Best Practices

There are many **best practices and rules** that have been established by **HCI researchers and designers**. These rules **include abstract design principles, to common-place standards, and design guidelines**.

Design for learnability and familiarity

Learnability and familiarity principles determine **how easily a novice user can learn to interact with a system**. To achieve this, a system should be **predictable**. Any **user should be able to predict the results of future actions based on the knowledge of their interaction history**.

Similarly, a user **should be able to map experiences with other computing systems to a new system**. Familiarity determines whether a user can initiate interaction. **Metaphors** (usually visual) are a common way that systems achieve this principle. **For example, a trash bin icon should represent the action to delete items, as it is familiar and predictable.**

Make elements legible and accessible

All **characters and objects must be perceptible in order to be used effectively**. Multiple modes of “legibility” **should be used to represent information (visual, verbal, and haptic).** Similarly, a system must equally useful to users with diverse abilities. **For example, users with visual impairment should be provided with equivalent support systems**.

Tolerance for error

Users will make errors, but they should not change the system state or impact an interaction disastrously. Warnings should be **provided to prevent potential mistakes, and a system should not have a critical situation that can be reached easily by the user**. A system must also **offer assistance when potential errors arise**.

Flexibility

Any design should **provide multiple ways to perform a given task**. This allows the **user to interact with a device according to their ability or preference.** Users need **options to choose methods that best fit their pace and experience**. Systems that are **flexible are more useful for a wide range of users.**

Don’t reinvent the wheel

It’s important to **innovate but not at the expense of learnability and accessibility**. Users **have developed old habits from other interfaces that will transfer to well-designed systems**. A design that **uses ready-made standards will be a more intuitive, useful product.**