REVISITING THE END USER’S PERSPECTIVE IN COLLABORATIVE HUMAN-ROBOT INTERACTION

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**HCI** --- Human-Computer Interaction

**HRI** --- Human-Robot Interaction
Goals

HCI

Computer

Human actor

Interaction Enablers
Interaction Designs
Technology as the Interface

HRI

Robot
User eXperience

Goals

Computer

Human actor

Robot

Interaction Enablers

Interaction Designs

Technology as the Interface
**EVOLUTION OF HUMAN-COMPUTER INTERACTION**

**DIGITAL WORLD**

**EARLY DIGITAL COMPUTERS**
- **VISUAL** interaction (GUI, direct manipulation, infovis)
- **MULTIMODAL** interaction (auditory display, haptics, sensory substitution)
- **DESKTOP** paradigm (desktop computer)

**PHYSICAL WORLD**
- **EMOTIONAL** interaction
- **IMMERSIVE** interaction (VR / AR)
- **PHYSICAL** interfaces (flexible and deformable HW, data physicalization)
- **UBICOMP** (home, city, transport)
- **SMART MATERIALS** interfaces (radical atoms, smart dust)

**CLOUD** robotics
- **EMOTIONAL** robotics
- **NATURAL, COLLABORATIVE** interaction

**EVOLUTION OF HUMAN-ROBOT INTERACTION**

The robot **UNDERSTANDS** HUMAN INTENTIONS

The robot **SENSES AND MONITORS** its environment

Robot **EXPRESSES** its intentions in natural, non-verbal language

Robot as a programmable tool (FENCED robot)

**EARLY ELECTRO-MECHANICAL ROBOT**

**NATURAL**, **COLLABORATIVE** interaction

**VISUAL** interaction (GUI, direct manipulation, infovis)

**MOBILITY**
HRI contributes strengths in:

- Physical manipulation
- Contact interaction with humans in the 3D space
- Advanced sensing and interpretation of the environment
- Tested collision-safety standards

HCI contributes strengths in:

- Assistance for technology to embrace the user
- The well-established concept of User Experience (UX)
UX in Collaborative Robotics

UX

“the result of a holistic assessment of the objective and subjective imprint left on the end user by every aspect surrounding the relationship between the person and the collaborative robot”

- the efficiency and effectiveness of the collaboration
- safety and perception of safety
- situational awareness and management of uncertainty
- overall workload
- fluency of interaction
- ergonomics
- aesthetics
- …
Situational Awareness
(the robot keeps the user informed about its intentions and understanding)

Uncertainty, surprise
(bad UX and dangerous)

UX in Collaborative Robotics
The Robot as an Interface

- Essential elements in a person-machine interface:
  - An INPUT device
  - An OUTPUT display
  - An interface design that minimises the gulfs of execution and evaluation

Examples of Some Initial Steps
Examples of Some Initial Steps
Examples of Some Initial Steps
Conclusions

• HCI and HRI have nearly converged as disciplines around the end user

• UX in collaborative robotics: Preserve situational awareness

• The collaborative robot as an interface
Thank you!

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