HUMAN-ROBOT INTERACTION
(NO NATURAL LANGUAGE)

1. INTRODUCTION AND DESIGN PRINCIPLES

ANDREA BONARINI

ARTIFICIAL INTELLIGENCE AND ROBOTICS LAB
DIPARTMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA
POLITECNICO DI MILANO

E-MAIL: ANDREA.BONARINI@POLIMI.IT
URL:HTTP://WWW.DEIB.POLIMI.IT/PEOPLE/BONARINI

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WHY DO WE NEED TO *DESIGN* HUMAN–ROBOT INTERACTION?

- It is now possible to design “intelligent” devices
- We not only expect to “use” the devices, but to “interact” with them
- Interaction experience should be both effective and enjoyable

HEALTH

- **Surgery**

- **Rehabilitation**

- **Prostheses**

ENTERTAINMENT

- **Toys**

- **Games**

- **Gadgets**

ENTERTAINMENT

SOCIAL ROBOTS

- **Public interaction (hotel, bank, mall, …)**

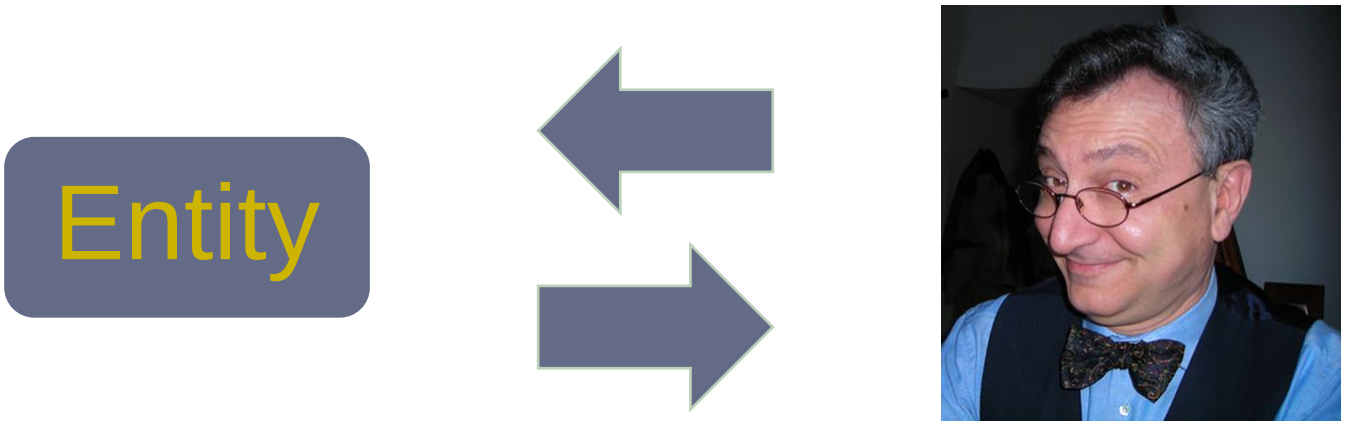
- **Elderly assistance**

- **Everyday life**

PEPPER,
A SOCIAL ROBOT

INTER-ACTING

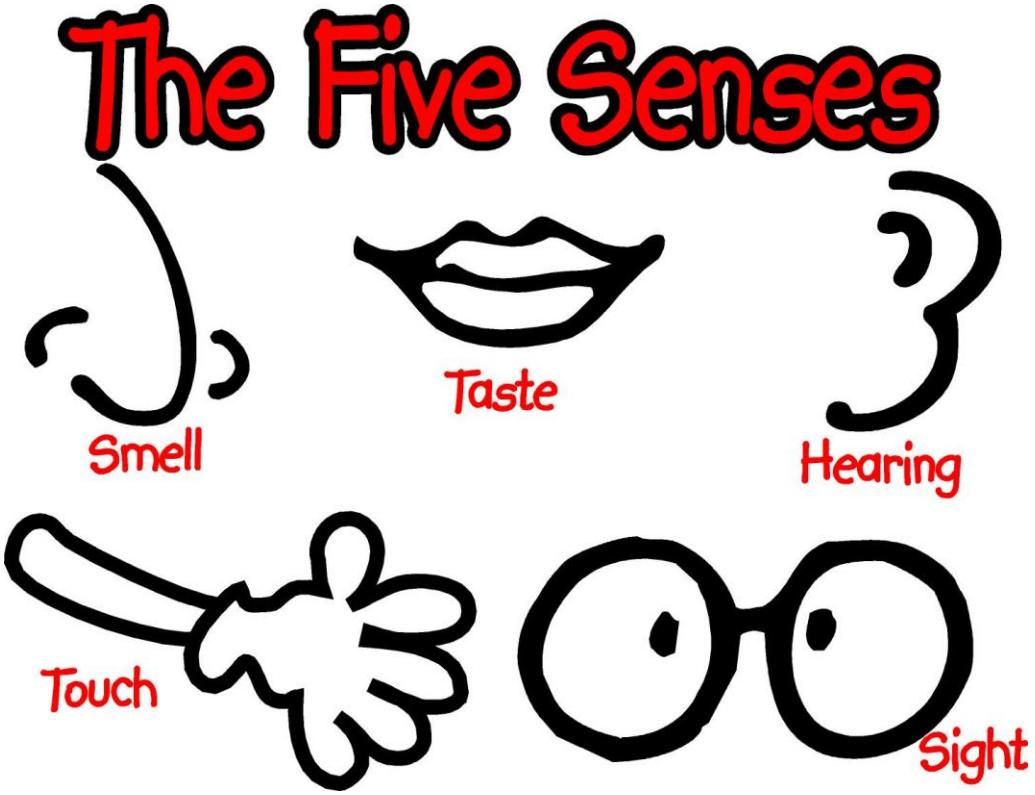
Inter-acting means that **different** agents **perform actions** so that each one **can perceive** what each other is doing:
they **exchange signals**



Communication

MULTI-MEDIAL INTERACTION

There are many different media that could be used to exchange signals, related to senses, our interaction channels:



SIGHT

- Light: colored lights
- Screen: words, artwork, pictures, …
- Movement
- …

HEARING

- Sounds (beeps, natural sounds, …)
- Music
- Words
- …

TOUCH

- **Gestural touch: caress, hug, slap …**
- **Vibration**
- **…**

SMELL, TASTE

Few applications

- **Difficult to produce signals:**
  - **electricity is not enough, matter is involved, and chemical reactions, too**
- **Difficult to detect signals by a device:**
  - **unstable and delicate sensors**
  - **difficult classification**

LET'S TRY…

Communicate that:

- **You are happy (sound, …)**
- **You are angry (touch, …)**
- **You need to drink (gesture, …)**
- **You need a toilet (sound, …)**
- **There is fire (touch, …)**
- **It's 10.35 AM (gesture…)**
- **You would like to know when the next train to Milan will leave (touch)**
- **…**

AS EXPECTED…

…not all the media are good for any interaction!

One of the most used among human beings is …
natural language

Well… not really. **Only 30% of human communication is done through natural language**, and body language is an important factor to complete interaction

Let's say that one of the most *intentionally* used mean among humans is (spoken or written) natural language: rich , shared, … ambiguous, fuzzy, …

Natural language without coherent integration with gestures is not appropriate for effective interaction

PURPOSEFUL INTERACTION

Any interaction act has a **purpose**

The most common and simple is aimed at obtaining (**ask**) or providing (**inform**) information

Another common interaction is used to order something (**command**)

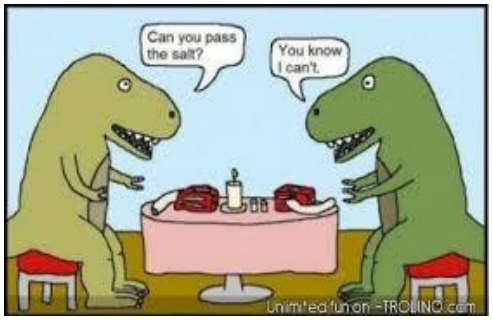
Other, possibly more complex, are aimed at obtaining or maintaining a state, reaction, social relation, or emotion

ACHIEVING THE PURPOSE

The purpose of the interaction can be either achieved or not

In verbal interaction, the purpose is called **perlocutionary** effect

E.g.: “Can you pass the salt?”



MULTI-MODAL BASIC ACTS

Extending Searle's theory of speech acts…

Locutionary acts

- What is done (turn on a light, beep, …)

Illocutionary acts

- The social meaning of what is done
  - Provide information
  - Ask
  - Commit
  - Reward, congratulate
  - …

Perlocutionary effect

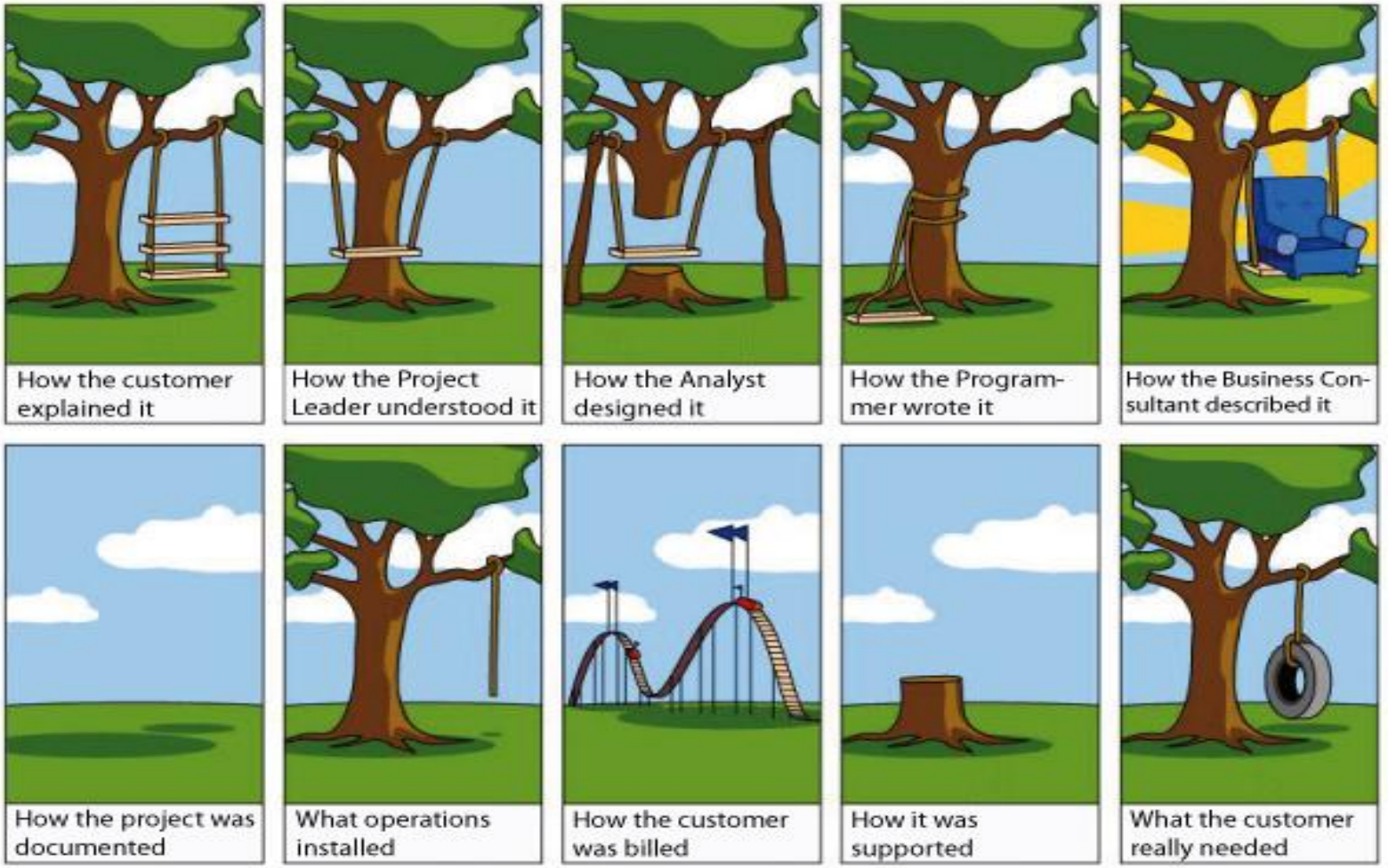
- What is produced by the interaction (information exchange, an action, pleasure, frustration, …)

THE INTERACTION PURPOSE

The **designer defines** the **purpose** of each interaction act, as well as its **modality**, since he/she is the one designing the application, **but …**

User-centered design

USER-CENTERED DESIGN



USER-CENTERED DESIGN

"***User Centered-Design (UCD)*** *is a* ***design philosophy*** *and a* ***process*** *in which the* ***needs, wants, and limitations of the end user are given extensive attention at each stage of the design process****. User-centered design can be characterized as a* ***multi-stage problem solving process*** *that not only requires designers to* ***analyze and foresee how users are likely to use the product****, but to* ***test*** *the validity of their assumptions w****ith regards to user behavior*** *in real world tests with actual users. Such testing is necessary as it is often very difficult for the designers to understand a priori what a first-time user of their design experiences, and what each user's learning curve may look like.*" (adapted from Wikipedia)

USER-CENTERED DESIGN PRINCIPLES

Usefulness

Usefulness relates to relevance: do the functions, information, etc. match what the user actually needs?

Usability

Usability relates to ease-of-use: a simple concept, but not always easy or intuitive to implement.

Apperance Design

Refers to the shape and the tools used for interaction (front-end)

SO THE USER IS THE DRIVER OF THE PROJECT…

HOWEVER…

“If I had asked people what they wanted, they would have said: faster horses.”

— Henry Ford

EQUILIBRIUM

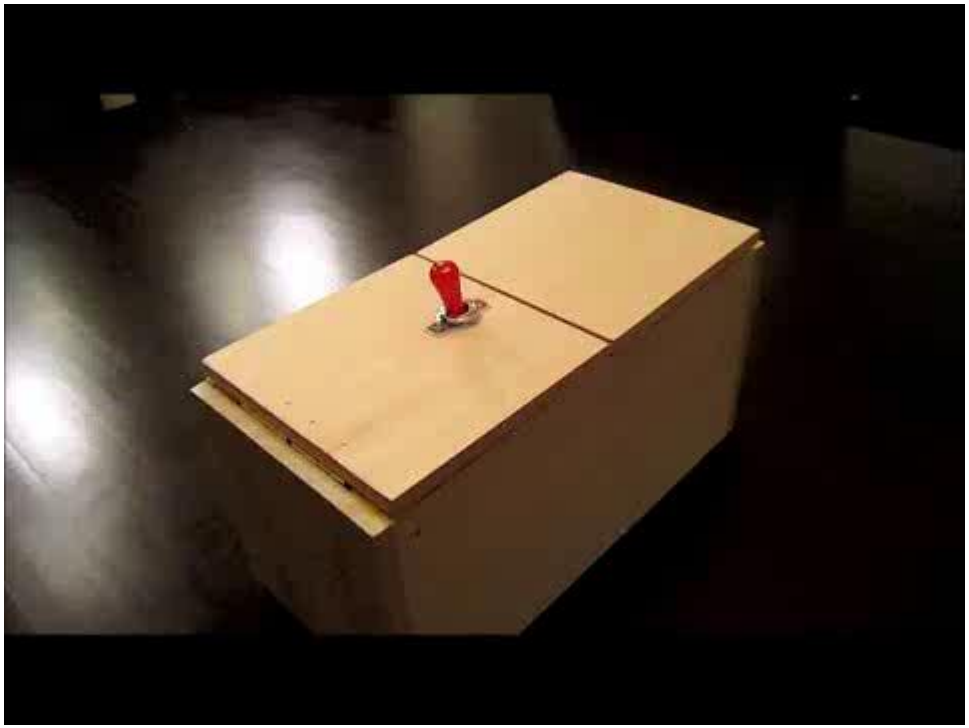
- **Collect the user's needs from the userS**
- **Decide what to do**
- **Try it with the userS (e.g., Wizard of Oz (WoO))**
- **Revise**
- **Implement**
- **Test with the real user (NO WoO)**
- **Deploy**

USER'S NEEDS

Any product should be made for a purpose

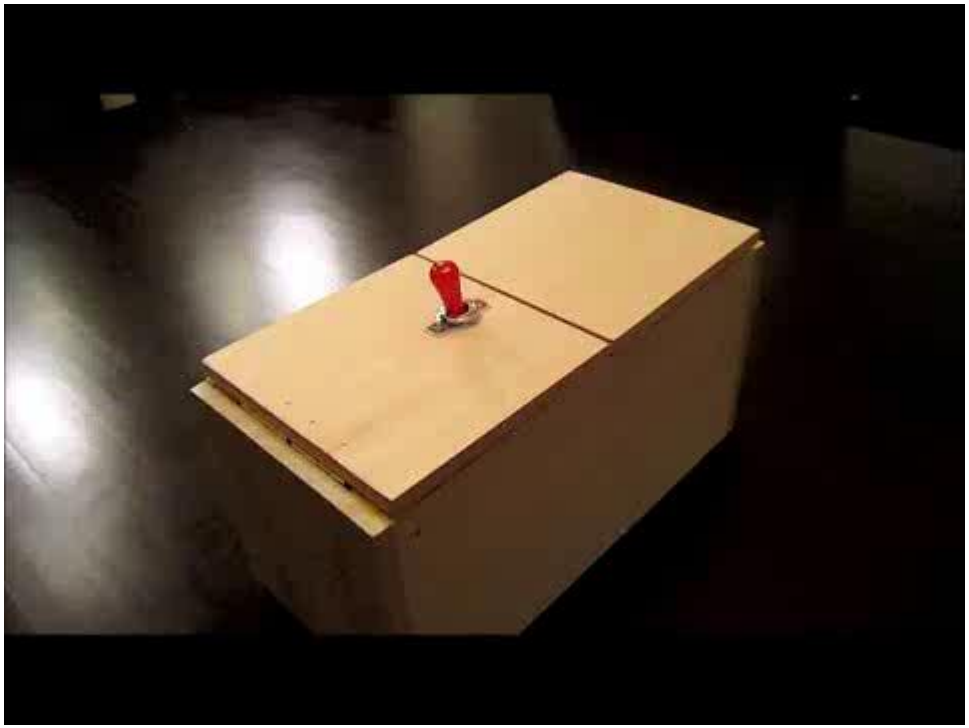
No user will use (buy) it, if it does not match her/his needs

User's needs can also be induced…



WHAT TO DO
TO MATCH THE NEEDS

- **Identify the interaction acts needed to match the needs**
- **Identify the modality**
- **Design the interaction**

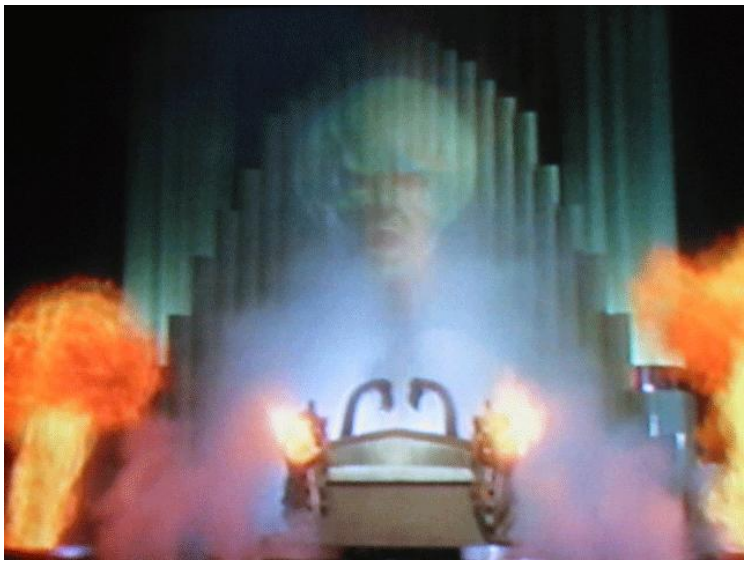


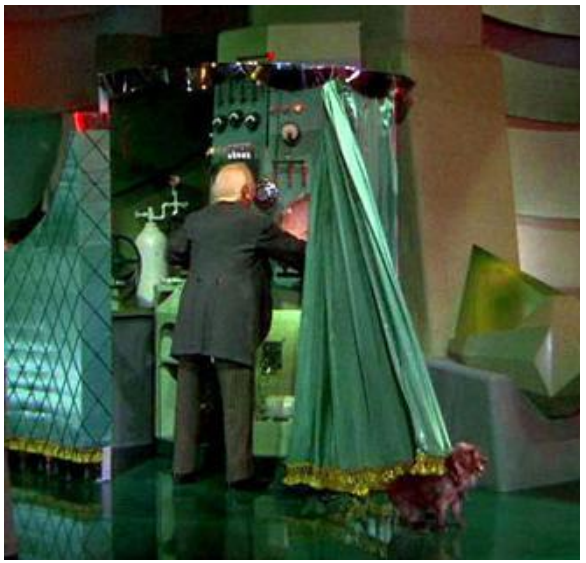
TRY IN ADVANCE

Test with the user the interaction, also without implementing anything

How?

E.g., Wizard of Oz (WoO)





REVISION

- **Check the decisions**
- **Revise according to the implementation possibilities**
- **Design the tests**

IMPLEMENTATION

- **Implement on the real devices**
  - The interaction experience depends on many factors: nothing can be different from the real one
- **Implement the real stuff**

FINAL TEST

- **Test the system in the real situations**
- **Test the system with representative users**
- **Test all the interaction sequences**
- **Evaluate the performance with appropriate tools and methods**

LET'S TRY…

Let's design the interaction for

- A *modern* washing machine

- A *friendly* vacuum cleaner