HUMAN-ROBOT INTERACTION
(NO NATURAL LANGUAGE)

4. TIME ISSUES

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DYNAMICS OF INTERACTION

When interacting with physical devices, many timing issues may arise and should be considered when designing the interaction, to make it:

- Effective
- Believable
- Acceptable
- …

RESPONSE TIME

Response time is the time from an interaction act and the consequent (expected) reaction.

The expected response time is coherent with the interaction: for instance, when people ask something, they expect to obtain an answer directly, or, at least a reaction stating that the question has been caught, i.e. the channel is open

If time is required to produce an answer, a signal can be issued to acknowledge to have understood and to take time.

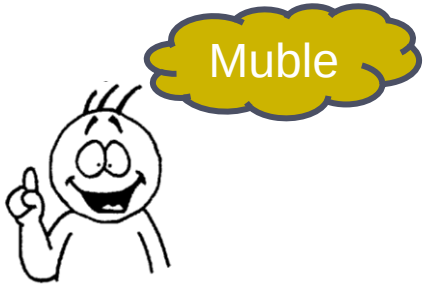
“Great question! Mmm, … let me think …”

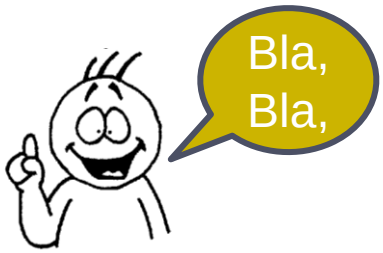
Even only a LED on when operating a button might be enough

RESPONSE TIME ISSUES

The response time may be affected by:

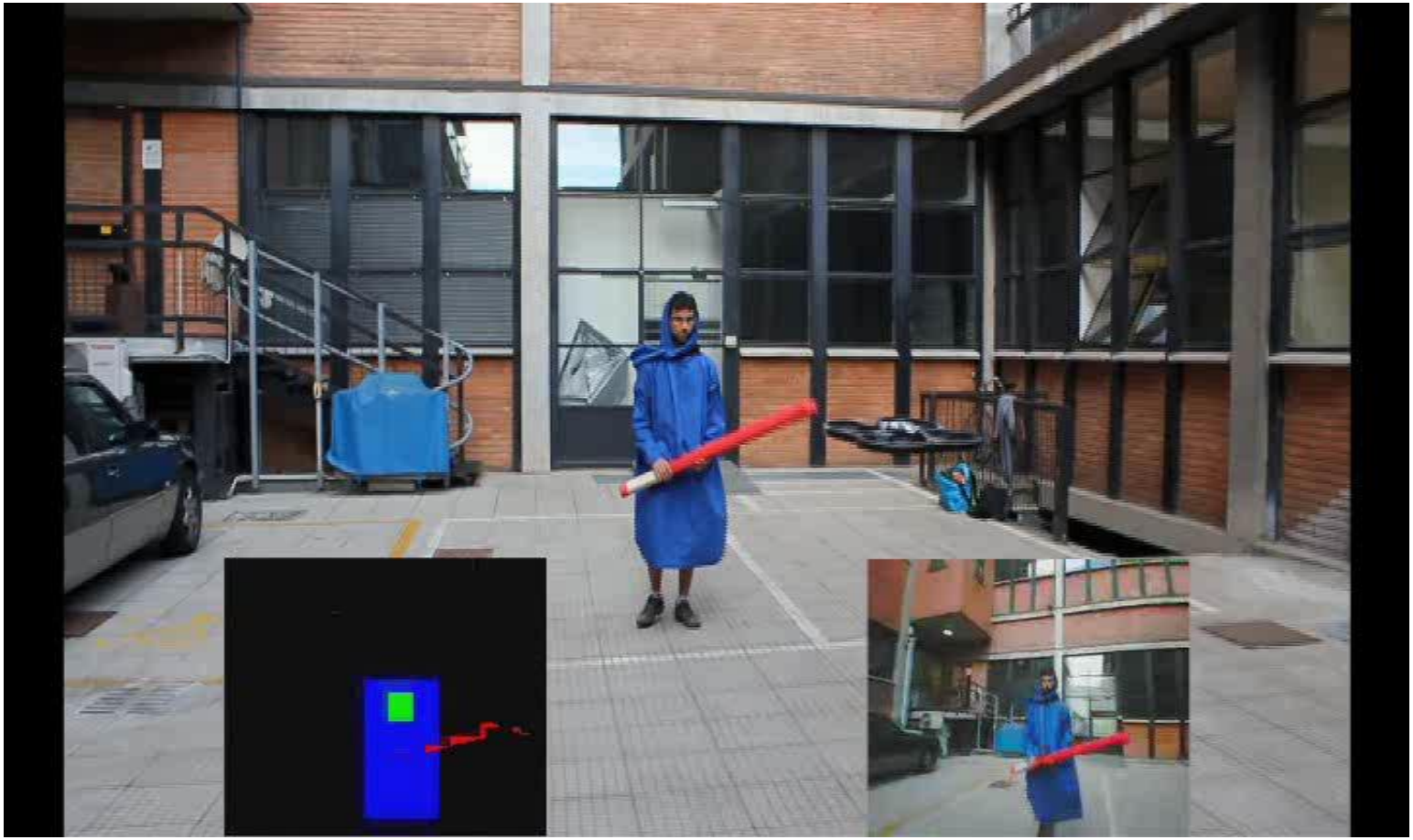
- Time required to understand the stimulus (e.g., natural language interpretation, image analysis, …)
- Time to elaborate the reaction (e.g., to decide what to answer, which movement to do, …)
- Time to produce the reaction (e.g., to produce an utterance, to move a part, to execute an order, …)





RESPONSE TIME EXAMPLE 1

Jedi Trainer: a robotic game with a good response time



RESPONSE TIME EXAMPLE 2

RoboWII 2.02L: a robotic game with a bad response time (well integrated)

RESPONSE TIME EXAMPLE 3

Geminoid: a good, critical response time

RESPONSE TIME EXAMPLE 4

PR2: a bad response time

DEVICE INITIATIVE

When the device takes the initiative, the time for its interaction action (duration from start to completion) should be coherent with the expectations.

For instance, if it starts to speak, it is expected that it speaks fluently until a reasonable end; if it starts to show something to which the user is expected to answer, it should leave time to the user to understand it.

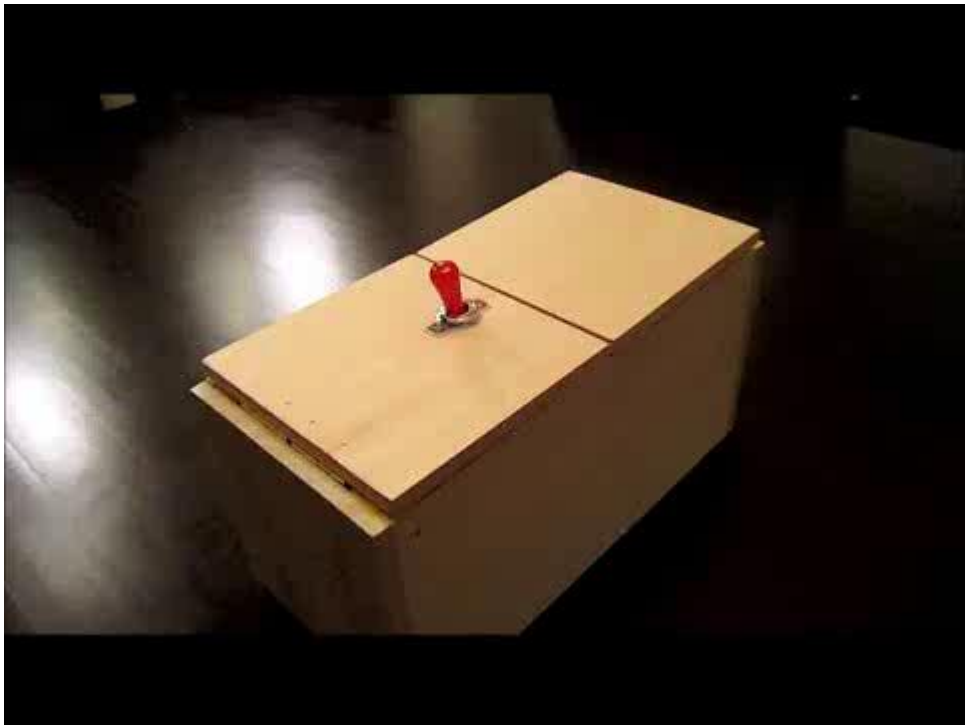
The termination of the interaction act should be clear as its content.

- No action
- Expected end reached
- Wait context clear

TURN TAKING

When an interaction is finished, there may be the case of deciding who is taking the turn for the next one => turn taking

Timing plays a fundamental role in turn taking, as it can easily seen in chat interactions via internet, or in tele-conferences, or… in real life.



SUBJECTIVE TIME

Time is extremely subjective, and the perception of time in interaction (and so, the quality of the interaction) could be modified by contextual information.

For instance: RoboTower game

LET'S TRY…

Let's focus on an intelligent hotel room.

What timing aspects could we have to face to design the interaction of a client with it?

IT'S ANALYSIS TIME

Up to now, we have seen many aspects of interaction, some modeling tools, some interaction media and many different devices that could interact with somebody.

It is now time to use what we know to analyze in details some systems where interaction is important

LET'S TRY…

Let's focus on one of the games we have seen

- What kind of interaction has been implemented?
- What kind of interaction acts are present there?
- Is there any incidental interaction?
- What kind of state diagram of interaction flow can be derived for this game?
- What kind of timing effects are there?
- How could it be better? What does "better" mean in this context?

TOWER GAME

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RoboTower

A strategic robotic game

ANALYSIS

Interaction acts

Related to cards. Cards implement orders. Channel issue: cards are not always read. Unexpected behavior is a cue for unsuccessful communication act. Report on the screen the use of the card. But this channel is not open due to cognitive load in the interaction with robot.

Interaction with towers (not intentional from the player point of view)

(Incidental) interaction with the robot through the distance sensors on the front. Once you understand the action of the robot in response to putting an hand or a foot in front of it, you can use this gesture as an “order” to make the robot go in a direction.

ANALYSIS

Interaction acts (from the interface)

The interface Informs about the usability of cards (visually) (channel not really usable since the visual channel of the user is dedicated to the robot)

The interface Informs the user about the towers' destruction by using a sound lasting 4 seconds, evocative. This was effective (channel free).

The timing of the game is shown (channel overloaded, but good for memory) and told by speech (channel open and available). Diversion of channel attention could be exploited.

ANALYSIS

State of the system

Idle / searching / execute order / aim at tower / escape from obstacle / end

Events: tower found, card got, obstacle found, red tower ruined, time consumed.

ANALYSIS

Timing effects

Prompt answer to the card, and to the obstacle, and also to tower destruction

Subjective time effect (pressure put on the players)

IMPROVEMENTS

Strong, immediate sound when the robot reads the card. Even better, light on the robot, since it exploits an open channel.

Sound on the robot to make explicit that something is in front. Color pattern on the obstacle to distinguish from hands.

More effective way to recognize cards (improve that channel).

LET'S TRY ONCE MORE…

Let's focus on a device you usually interact with (car, phone, camera, kitchen fire, washing machine, fridge, vending machine, …)

- What kind of interaction is (or could be) implemented?
- What kind of interaction acts are possible?
- Would there be any incidental interaction?
- What kind of state diagram of interaction flow can be derived for this game?
- What kind of timing effects are there?
- How could it be better? What does "better" mean in this context?