HUMAN-ROBOT INTERACTION (NO NATURAL LANGUAGE)

2. SENSORS AND ACTUATORS

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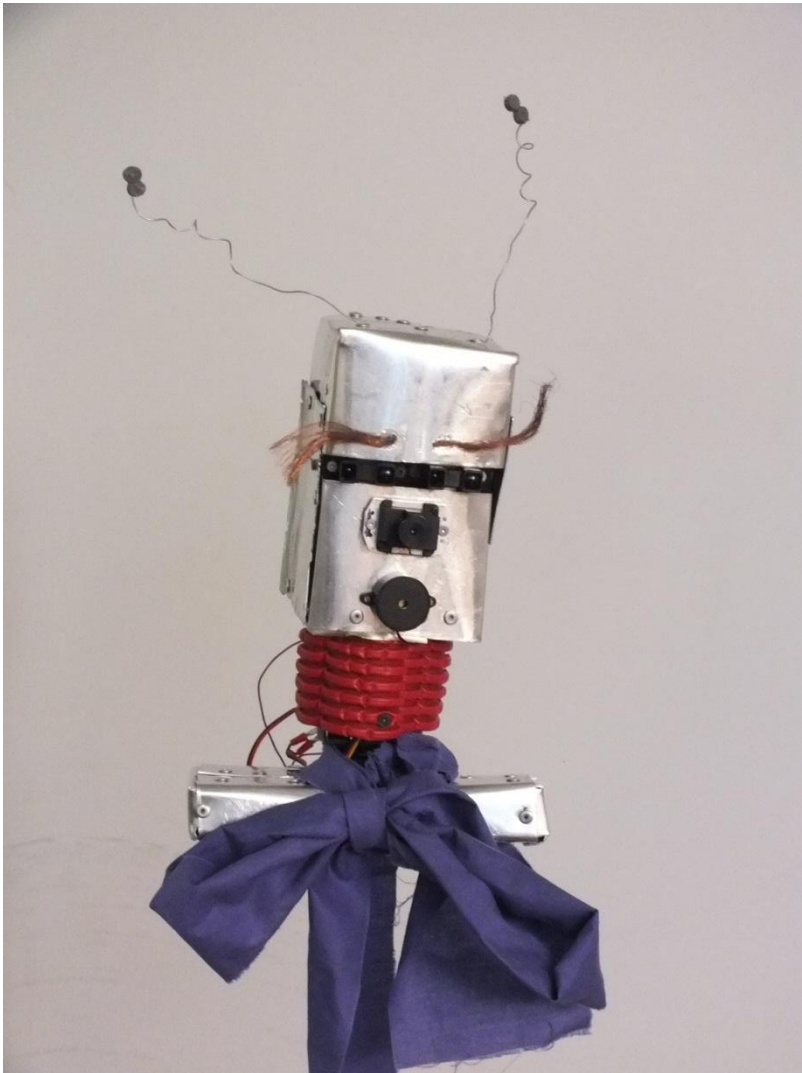DIPARTMENTO DI ELETTRONICA, INFORMAZIONE E BIOINGEGNERIA

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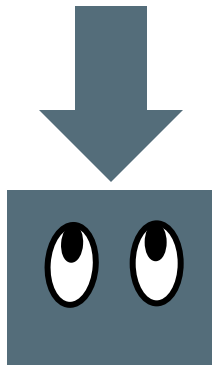
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THE DEVICE SIDE...

From the device side we have to **exploit the output channels (actuators) compatible with the human ones,** and we can **classify the input channels (sensors) according to the available technology**

SENSORS

- They are the **input communication channel**

- They are the **only way to perceive signals**

- They usually **require some computation to interpret the signal**

- They have **constraints**, e.g., range of the measured values, and operating conditions

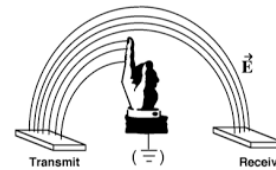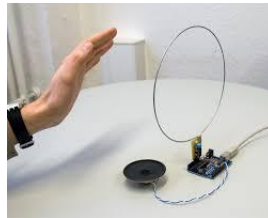- They may be affected by: **error, approximation, imprecision, discretization, ambiguity, uncertainty,** …
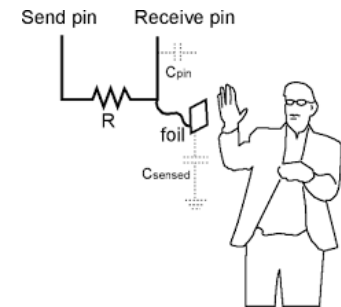
SENSORS: DISTANCE

Distance from the sensor

- Distance from **anything** (infrared, sonar, laser)

- Distance from **body** (capacitive sensor)

Send pin   Receive pin

- Distance from a **recognized object** (camera, kinect)

SENSORS: OBJECT FEATURES

- **Color**
  - Color sensor
  - Camera

- **Shape**
  - Fixed shape (e.g., recognition of a signal, a landmark)
  - Body position (e.g., face, expression, arm position, …) (camera or Kinect)
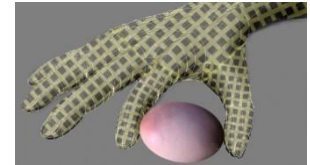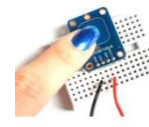
- **Tags (ID)**
  - RFID, …
  - Linguistic Tags
  - QR-code

SENSORS: OBJECT FEATURES

- **Surface**

  - Contact (switch)
  - Kind of surface (touch sensors)

- **Temperature**

  - T sensors
  - Thermal camera
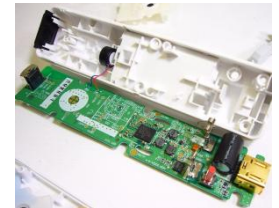
SENSORS: MOVEMENT AND FORCE

- **Acceleration**
  - 3-axis accelerometer
  - Camera, Kinect

- **Speed**
  - Rotational speed (gyroscope)
  - Tangential speed (camera, proprioceptive sensors)
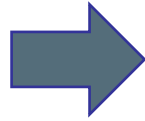
- **Force**
  - Fixed force (calibrated switch)
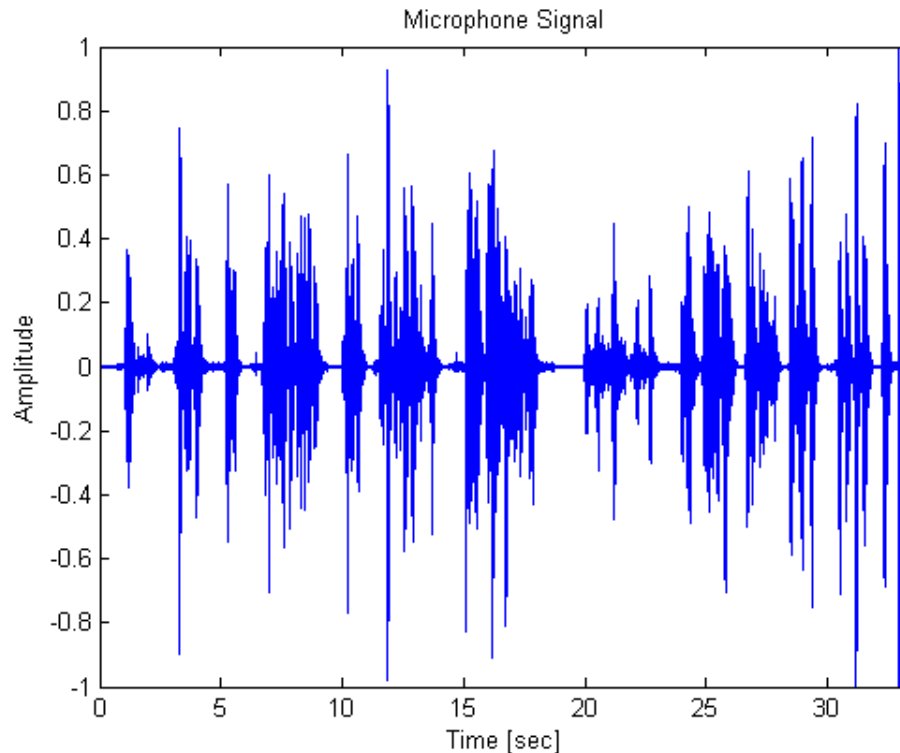 - Generic force (piezo, resistive, and other sensors)

SENSORS: SOUND

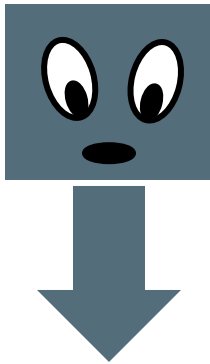- **Microphone**
  - Amplitude
  - Frequency

  →
  - Beat
  - Specific sound
  - Rhythm
  - Voice (kind, content, prosody, …)

- **Microphone array** →
  - Sound direction

Microphone Signal

ACTUATORS

- They are the **output communication channel**

- They are the **only way to emit signals**

- Some of them may require some **computation to generate the signal**

- They have **constraints** (range of the signal feature and operating conditions)

- They may be affected by: **error, imprecision, discretization, …**

ACTUATORS: MOVEMENT

- **Displacement of the device**

https://www.youtube.com/watch?v=HTxdKi77G20

- **Moving parts (eyes, arms, …)**
  http://www.youtube.com/watch?feature=player_embedded&v=JgGvArz1X40
  https://www.youtube.com/watch?v=-aNntrzEGVo

- **Deformating body**
  http://youtu.be/ZOaT2A_VJ5A

ACTUATORS: SOUND

- **Simple sounds (whistle, beep, …)**

- **Music**

- **Voice**

Sound is produced by waving air to our ears: the more air the more intense is the sound

ACTUATORS: LIGHT

- **Simple (coloured) light**

- **Light patterns**

- **Screen**

SIGNAL CHARACTERISTICS

Most signals (I/O) have common characteristics that could be used in interaction:

- **Intensity (amplitude)**
- **Frequency (color, tone, pitch, …)**

- **Speed**
- **Acceleration**
- **Rhythm, pattern**

- A gentle order
- A urgent request
- A gentle inform
- A formal excuse
- A reassuring promise
- …