

YOJI: eyes, ears, legs for overseeing



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Context: « défi carotte »

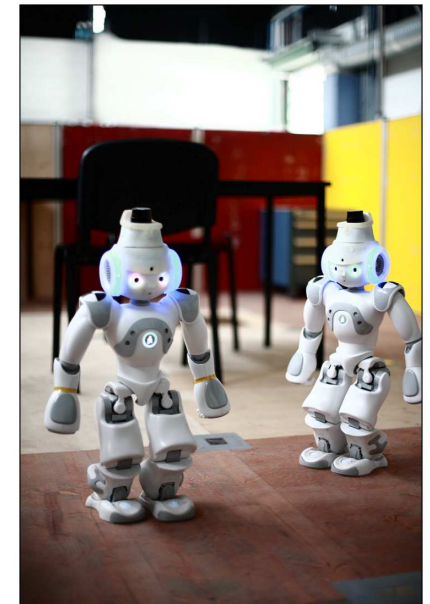
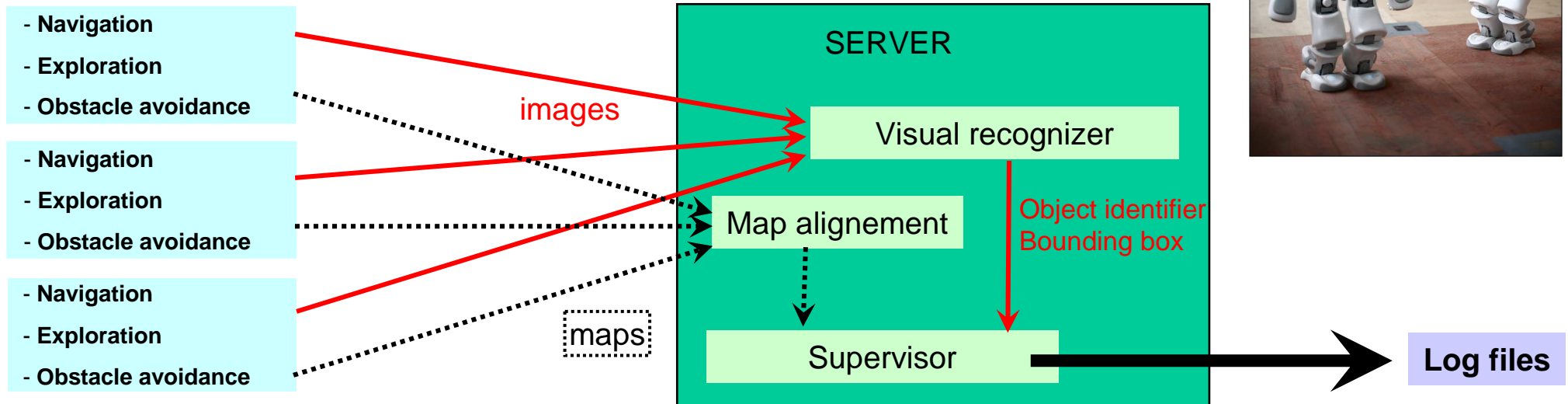
- **« défi carotte » (2010 – 2012)**
 - French acronym for « mapping a territory with a robot »
 - Goals:
 - To support the innovation in robotic, with a focus in perception and its application
 - To favour the collaboration between researchers and robotic industry.
- **The YOJI consortium:**
 - **Aldébaran Robotics:**
 - Global integration on the platform (modified Nao)
 - Navigation, localization
 - Exploration (multi-robot strategies)
 - **CEA LIST:**
 - Visual recognition (objects, wall, grounds)
 - **Voxler**
 - Sound recognition
- **External students (Ecole Centrale Paris)**
 - HCI interface to “replay” a mission
 - 1 year project for 5 students

Tasks to solve

- **Several challenging tasks:**

- Produce a metric map of an unknown environment
- Identify the rooms
- Recognize:
 - The objects and localize them with each room
 - The nature of walls and grounds in each room

- **Global architecture**

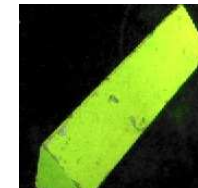


- **Which sensors for that?**

- Add a laser to Nao
- Use 3 robots simultaneously
 - Requires to realign the 3 maps
- Two cameras (bottom, up)

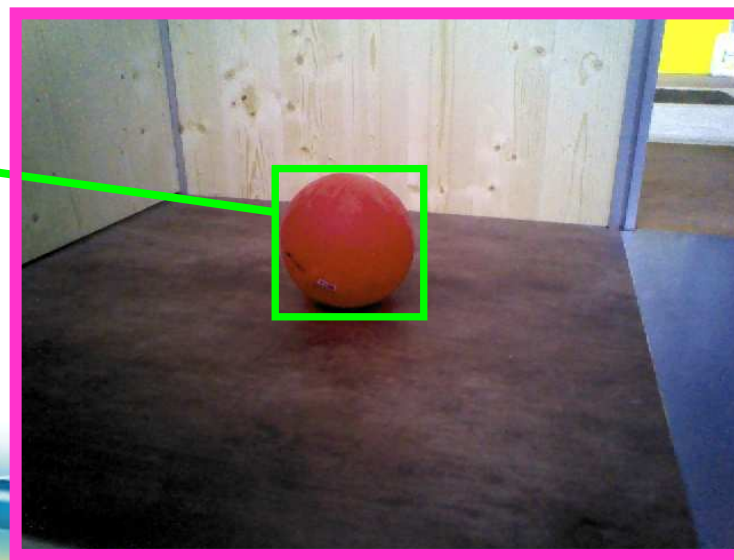
The difficulty of recognition

- **No information on depth:**
 - No information on the 3D shape
 - No information on the localisation
 - No pre-segmentation:



With depth:
is it one of these objects
here?

(→ CBIR)

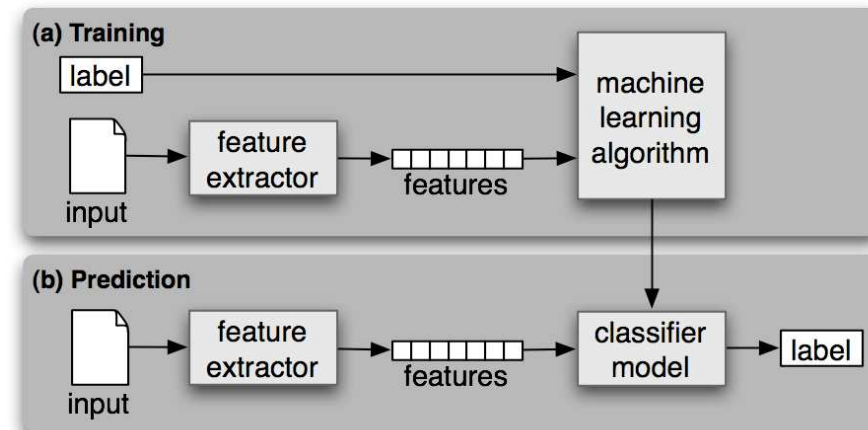


Without depth:
1 – is there one of these
objects in this image?
2 – where ?

(→ classification at
each box/scale)

Visual recognition

- **Visual recognizer server**
 - The robot prepare a JPEG image
 - The robot send a signal to the server when ready
 - The server picks the image
- **Object recognition**
 - Supervised classification
 - Very textured objects (local descriptor)
 - Weakly textured objects (global texture + global color)
- **Texture (wall, ground) recognition**
 - Semi-global description (4x4)
 - Fast Shared Boosting learning
- **Localization into the map (supervisor)**
 - Estimate robot object distance (homothety)
 - Use the robot position and pose
 - Log the object and check to avoid multiple detection



Very textured objects

- **Use of local descriptors**

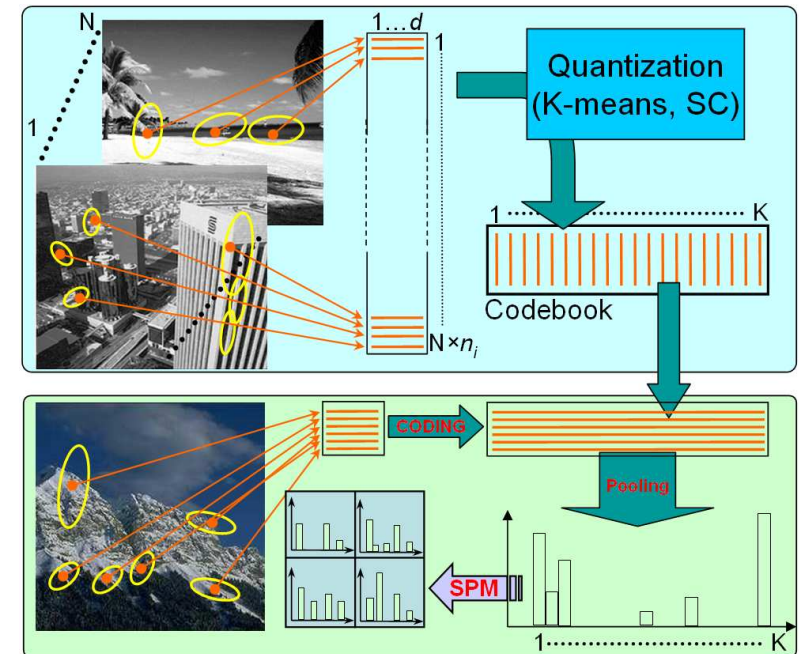
- Requires “strong contrasts”
- Can use a dense grid
- Generalization (BoV)
 - [Shabou & Le Borgne, CVPR 2012]

- **Point matching**

- Fast search (FLANN)
- Estimation matching (RANSAC)

- **Pose estimation**

- Several models



Weakly textured objects

- **Description**

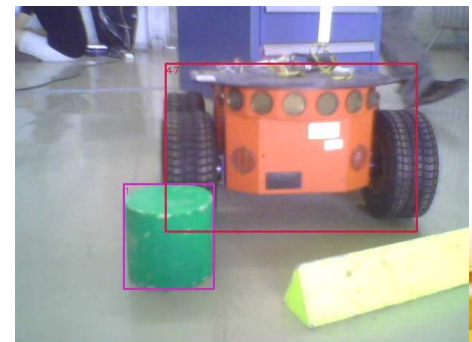
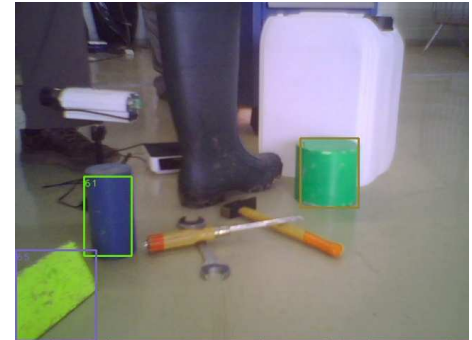
- Global texture + colour
- Estimate the probability at each point
- Can be used with any histogram description

- **Fast localisation**

- Approximation of Bhattacharya kernel
- Efficient subwindow search (branch-and-bound)

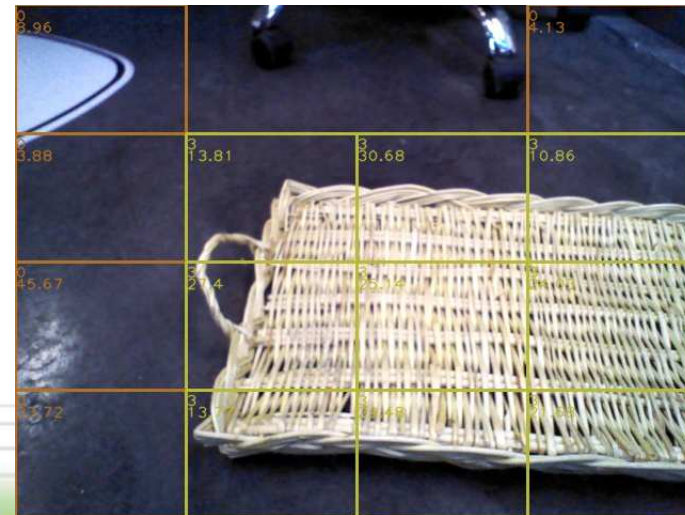
- **Robustness**

- Very good for occlusion
- Sensible to luminosity (colour)
- Problematic pose estimation
 - Position is confirmed by the robot



Wall and ground recognition

- **Based on “texture recognition”**
 - Semi-global description (texture + colour)
 - Help to avoid dangerous obstacles (gravel, dirt)
- **Fast shared boosting**
 - Boosting: build a strong classifier by summing weak classifiers
 - A weak classifier is shared among several features
→ memory saving
 - Fast learning (linear with respect to any parameter)
 - Appropriate random choices
 - [Le Borgne & Honnorat, *Multimedia Tools and Applications* 2010]



Replay a mission

- One year project by five students from Ecole Centrale Paris
 - Rudy Bunel, Paul Dib, Mohamed Essaki, Mathieu Garivet, Pauline Luc

The screenshot shows the Nex 1.0 software interface for mission replay. The main window displays a top-down map of a robot's path in a room, with a timeline bar above it. A pop-up window on the right shows details for a 'Chaise a 4 pieds N° 1' object, including its position (X: 5735, Y: -1148) and interaction details. The left sidebar shows 'Informations' with 'OBJET TROUVÉ' and 'Caisson outillage N° 1'.

Informations

OBJET TROUVÉ

Caisson outillage N° 1

X : 5870

Y : 3550

Classe de l'Objet : Non D...

Trouvé dans Piece N° 6

Carte

Position : (5870, 3550) mm

Mission : Nouvelle_Mission.nao

Chaise a 4 pieds N° 1

Position

Piece N° 0

X : 5735

Y : -1148

Objet

Classe de l'Objet : Non Défini

Sous-Classe de l'Objet : Chaise a 4 pieds

Interaction

Nature de l'interaction : -1

Date de l'interaction : -1

Fermer

Conclusion

- **Demo**
 - Recognition of textured objects
 - Recognition of weakly textured objects + confirmation
 - Replay HCI
- **Results**
 - **Wall and grounds**
 - Very good results but requires fine integration to decrease false positive
 - **Textured objects**
 - OK from 1 to 3 meters
 - **Weakly textured objects**
 - Sensitive to luminosity (→ false positive)
- **Perspective**
 - Increase robustness to luminosity
 - Improve integration with the platform Nao
 - Use depth...