Robot Vision

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DI TECNOLOGIA

Robot Vision - Contents

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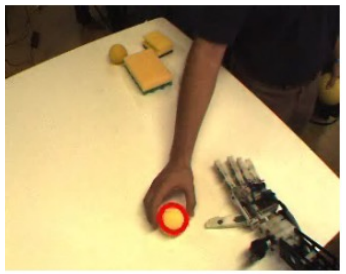
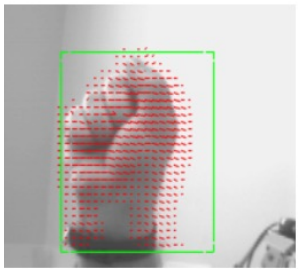
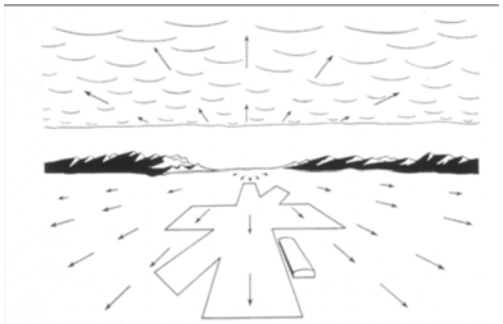
01 – Introduction to Computer Vision

Why should we study Vision

- It is a powerfull perceptual modality (the most powerfull?), allowing the acquisition of very rich information of the surrounding environment
    - *Object position and velocities*
    - *Relationships among objects*
    - *Object identity*
    - *Interact with the world in a non-invasive way (without physical contact)*





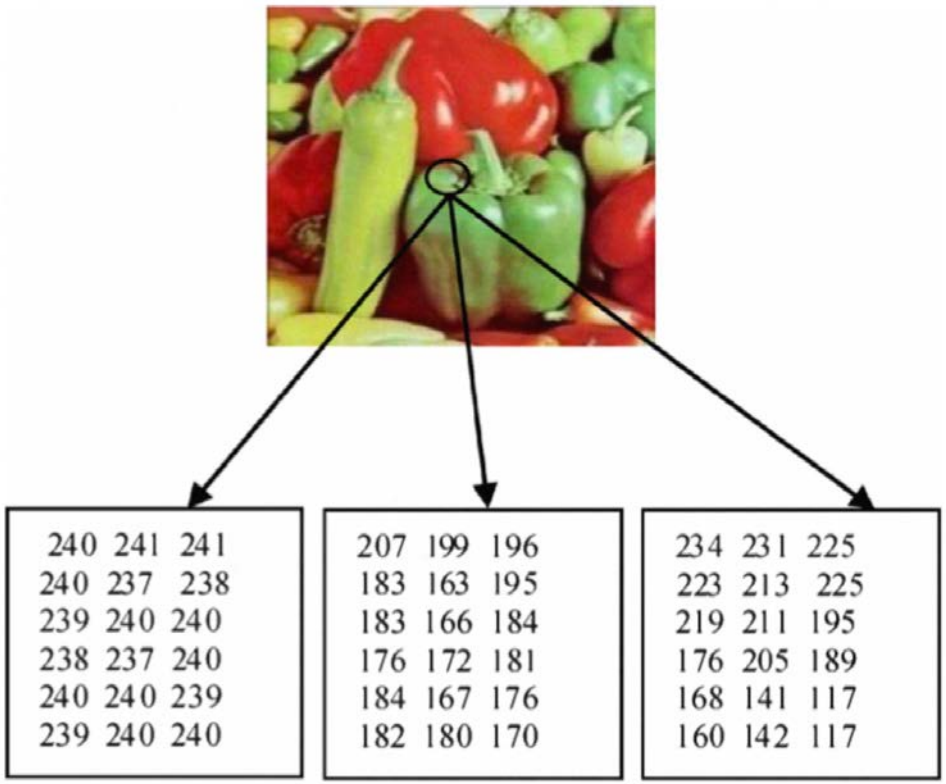


- Complex perceptual system. Above 50% of the human visual cortex is dedicated to processing visual information

- Biological systems are still not very well understood

01 – Introduction to Computer Vision

What is an Image?



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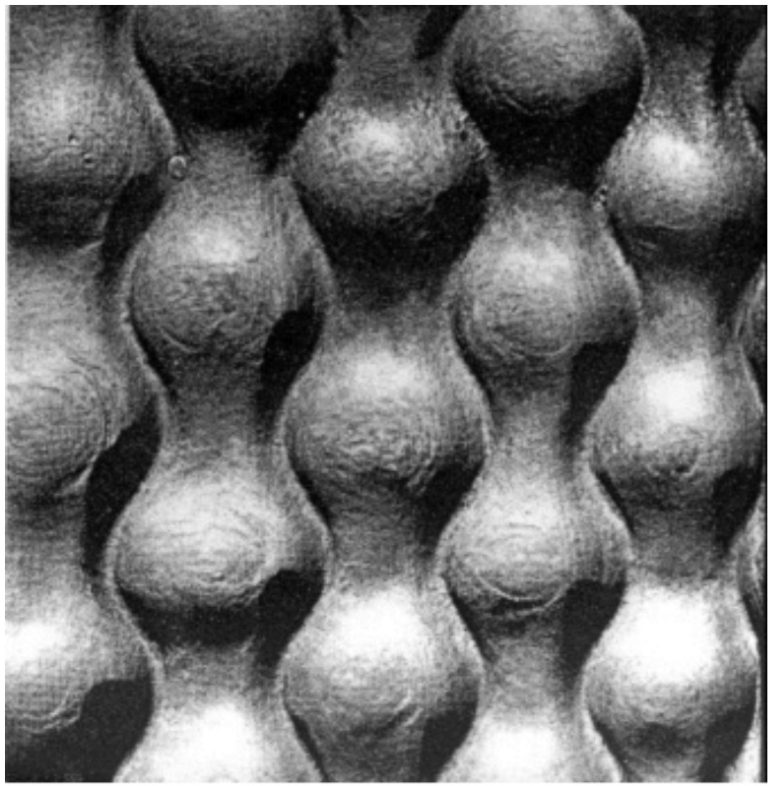

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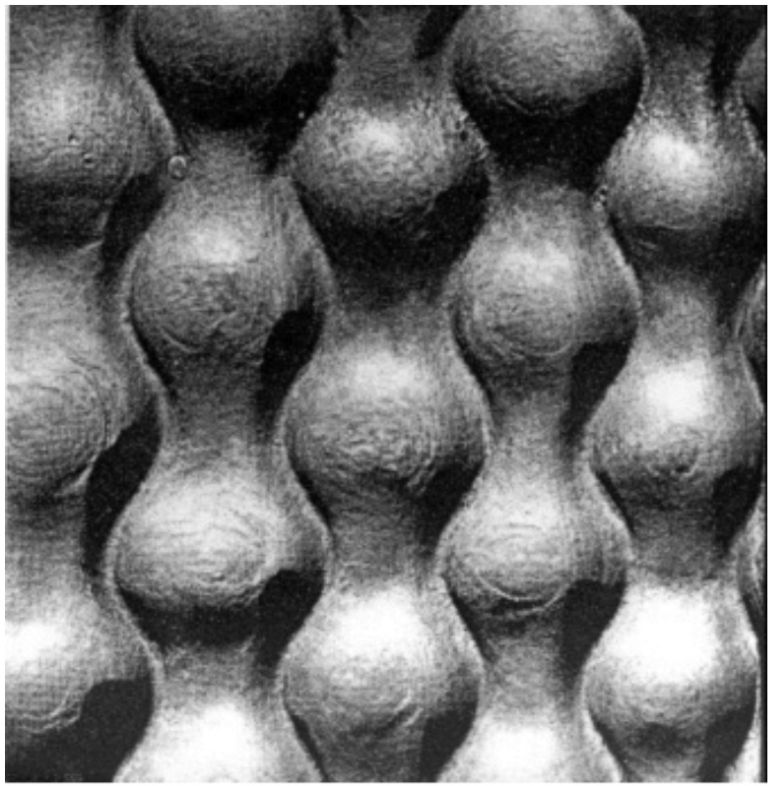
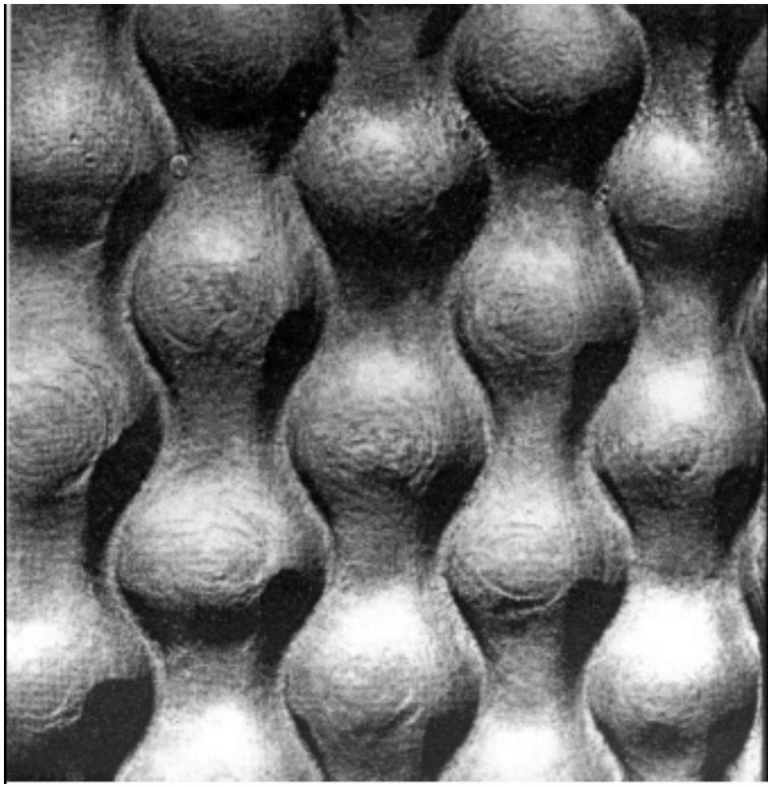




01 – Introduction to Computer Vision

Make computer/robots understand images and videos

Specific Recognition Tasks
- Outdoor, indoor
- City, forest, factory

Image Annotation
- Street
- People
- Buildings
- Mountains
- Tourism
- Cloudy
- Bricks

01 – Introduction to Computer Vision

Make computer/robots understand images and videos

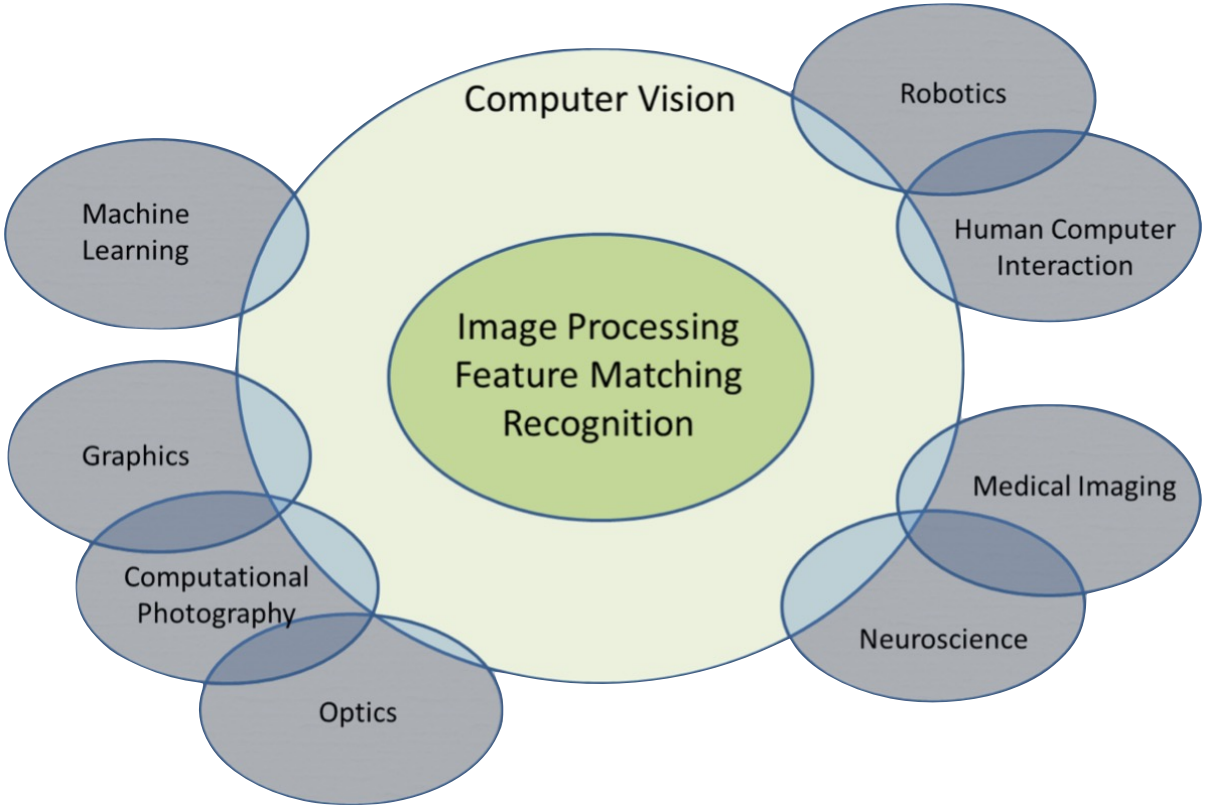
Object Detection

- Find Pedestrian

Image Segmentation

01 – Introduction to Computer Vision

Computer Vision Scope



01 – Introduction to Computer Vision

Computer Vision is Challenging…

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Computer Vision is Challenging…

First task:

- Find remote control

01 – Introduction to Computer Vision

Computer Vision is Challenging…

More realistic tasks:

- Where was this picture taken?
- How many people are there?
- What are they doing?
- What is the object the person on the left is standing on?
- Why is this a funny picture?

01 – Introduction to Computer Vision

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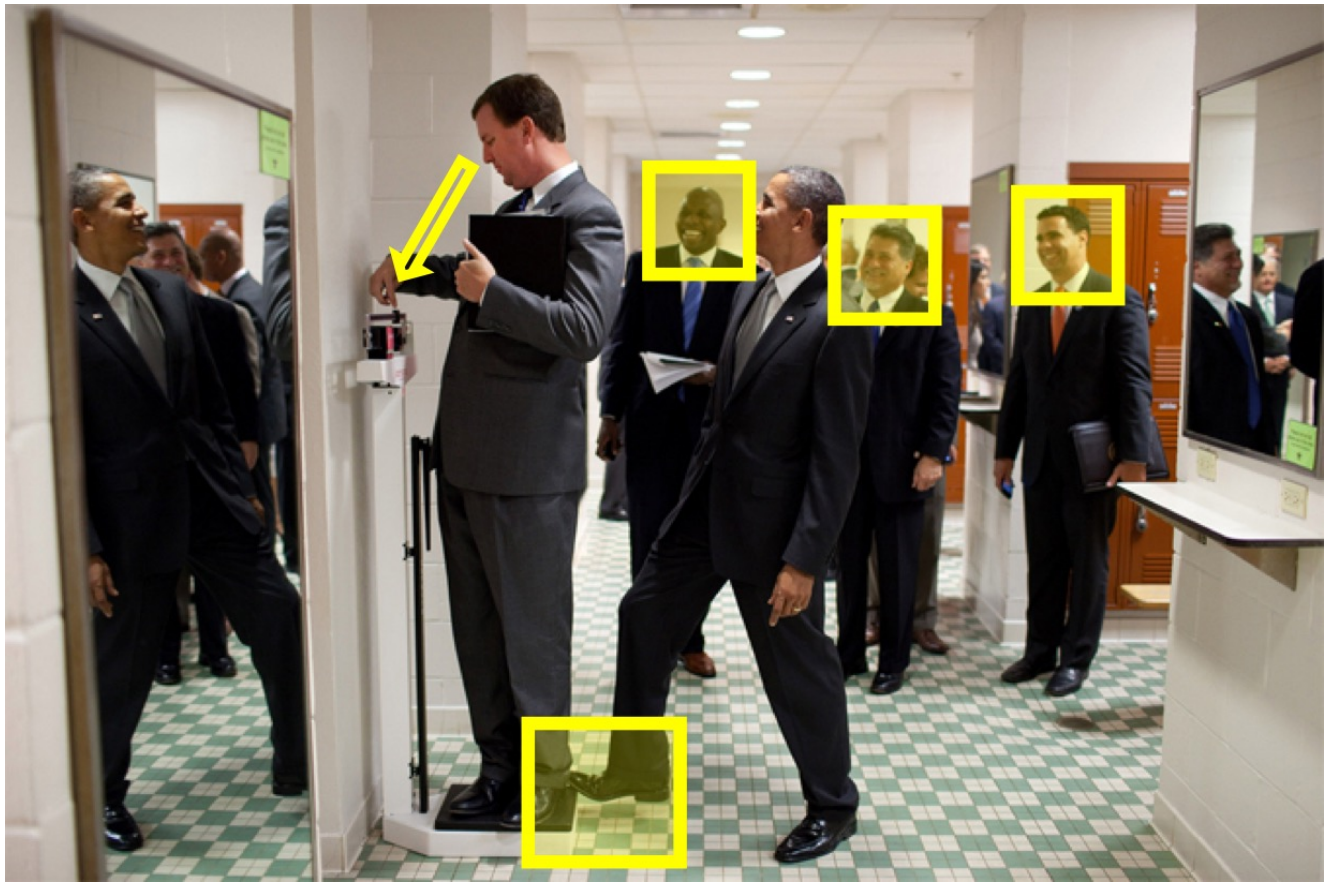

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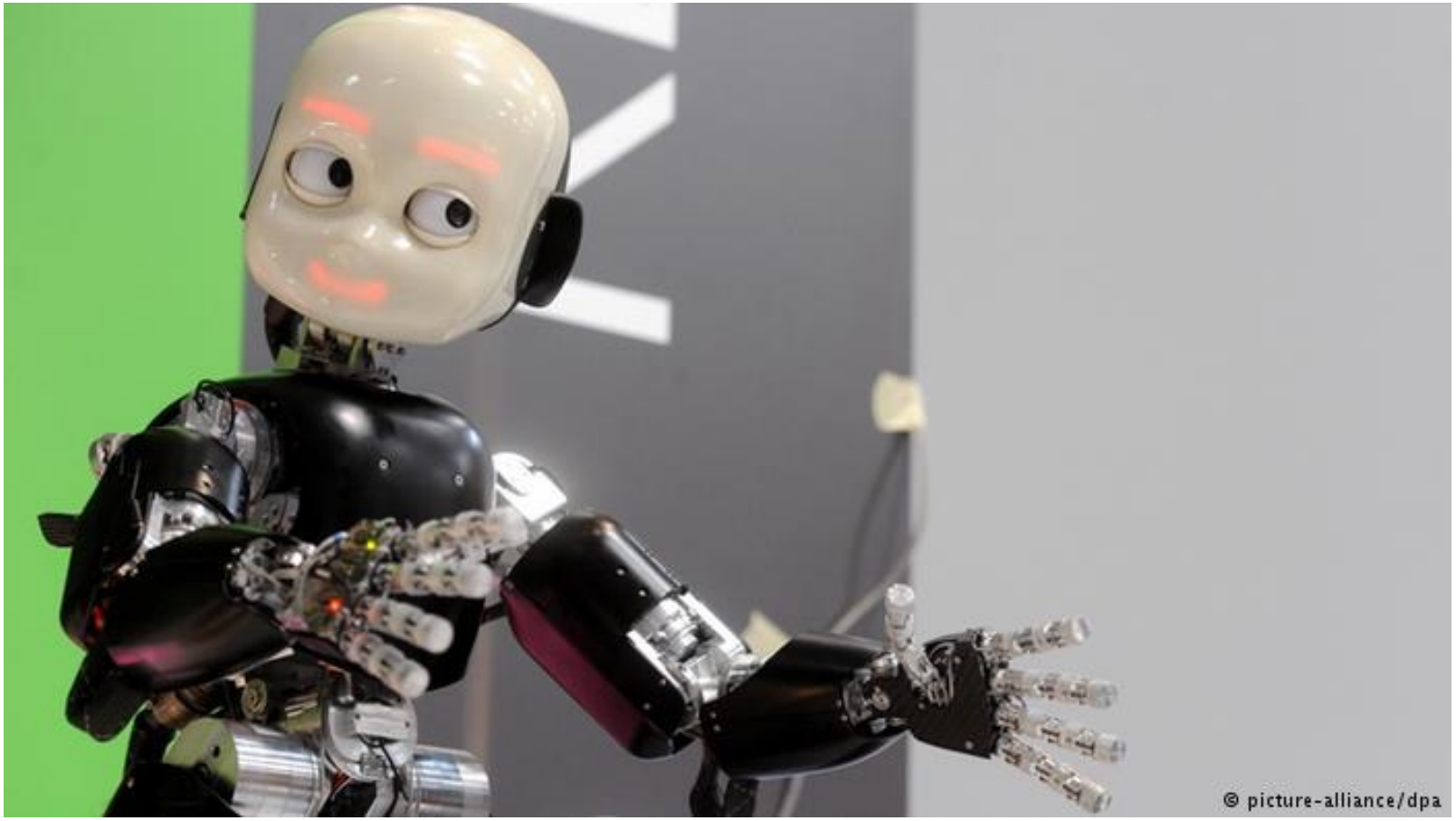
02 – Robot Vision Part 1



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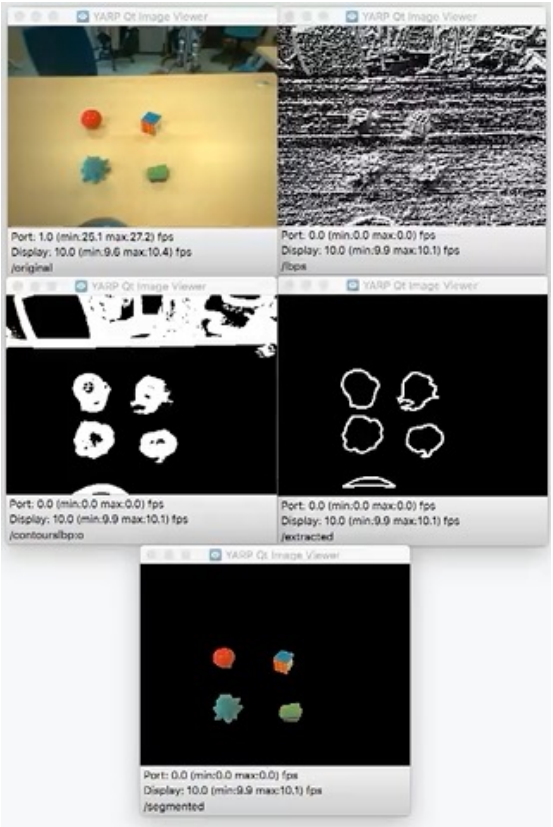

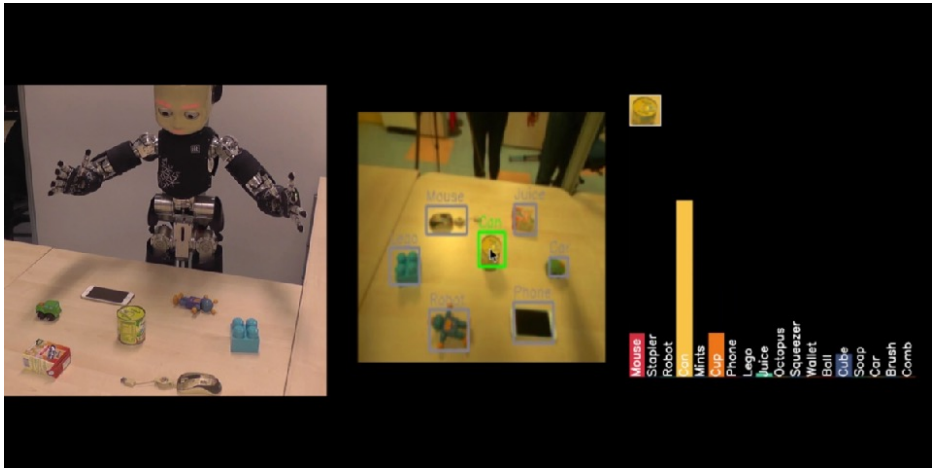

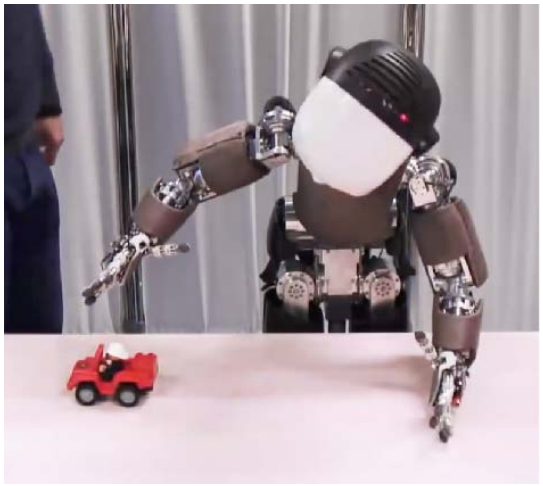

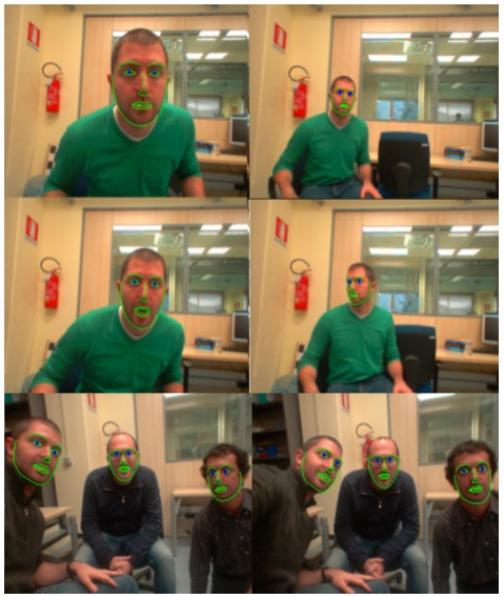

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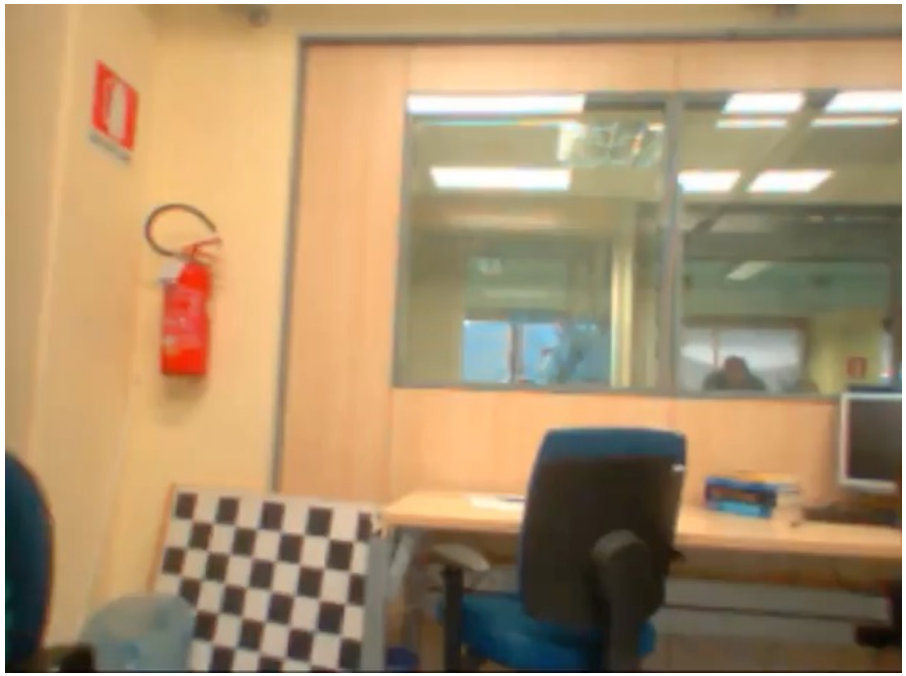

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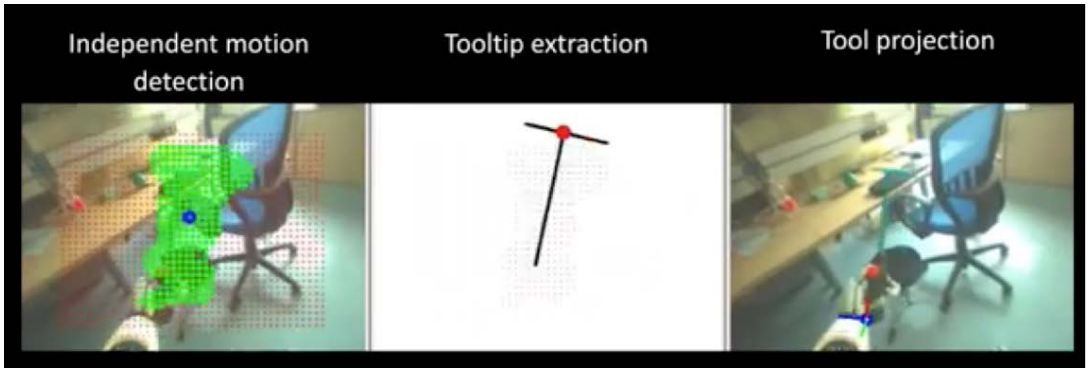
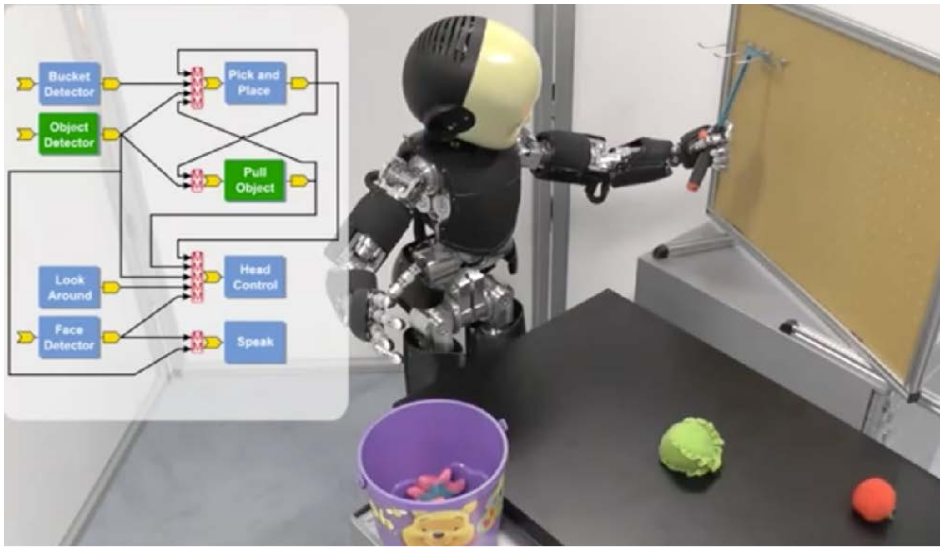
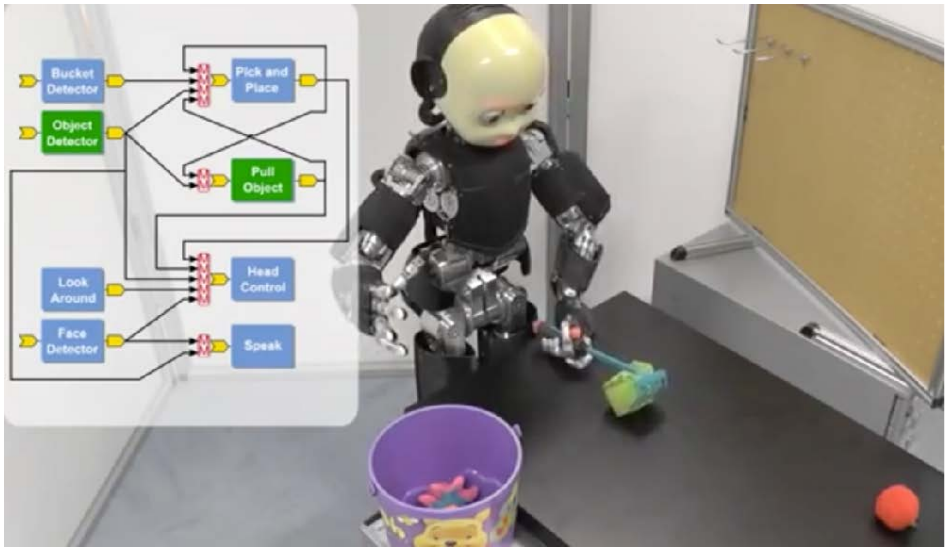
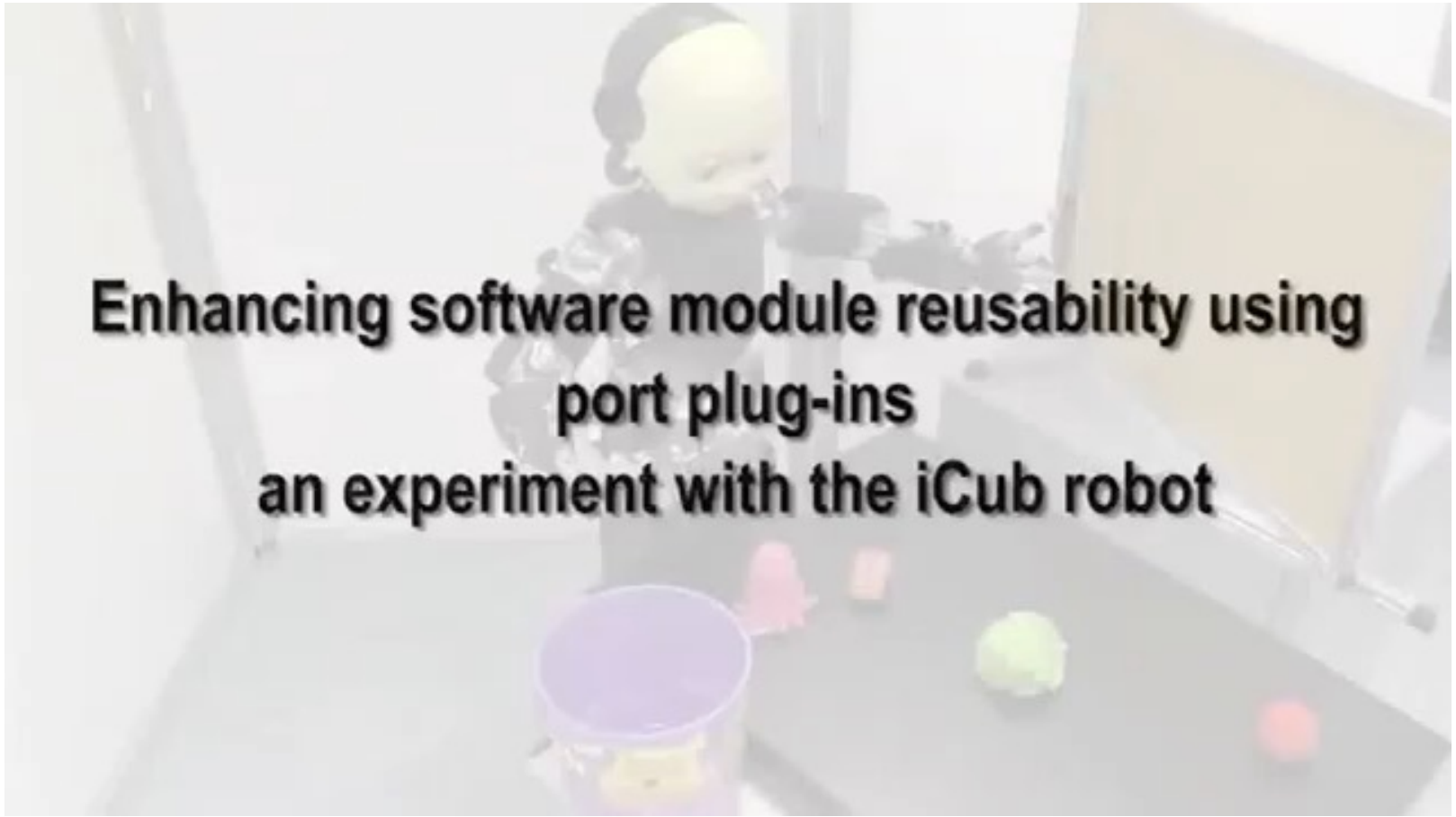






02 – 2D Robot Vision



02 – Robot Vision Part 1

Image Processing

What is meant by image processing?

- It is an umbrella term for many functions that:
  - Analyses images
  - Convert one representation into another

- **Perform operations** on an image to:
  - get an enhanced image,
  - **extract** useful information from it.
- Type of **signal processing**
  - **Input is an image**
  - **Output is an** image or characteristics/features
- Examples
  - Filtering
  - Image Enhancement
  - Edge detection
  - Segmentation
  - Image Analysis

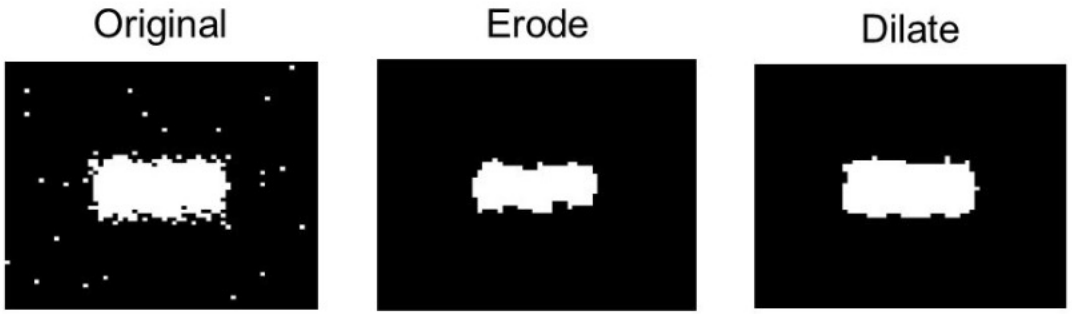
Applications that Process Images

- Object segmentation
- Face recognition
- Iris recognition
- Fingerprint recognition
- Character recognition
- Mathematical morphology
- Detecting Edges

02 – Robot Vision Part 1

Image Processing

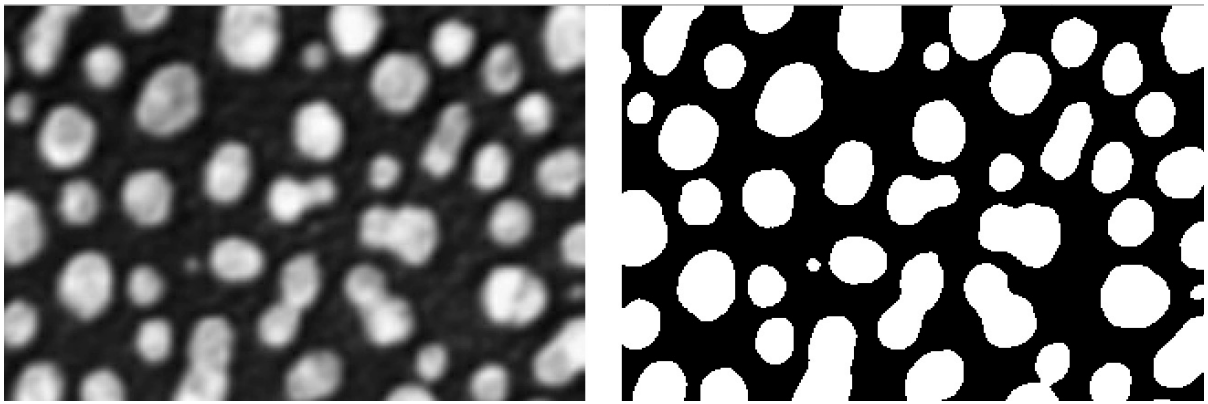
- Erode original image.
- Dilate eroded image.
- Smooths object boundaries, eliminates noise (isolated pixels) and maintains object size.



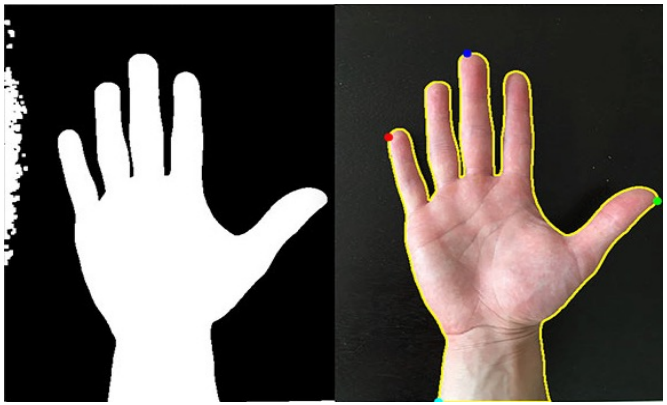
02 – Robot Vision Part 1

Image Processing

Thresholding Image



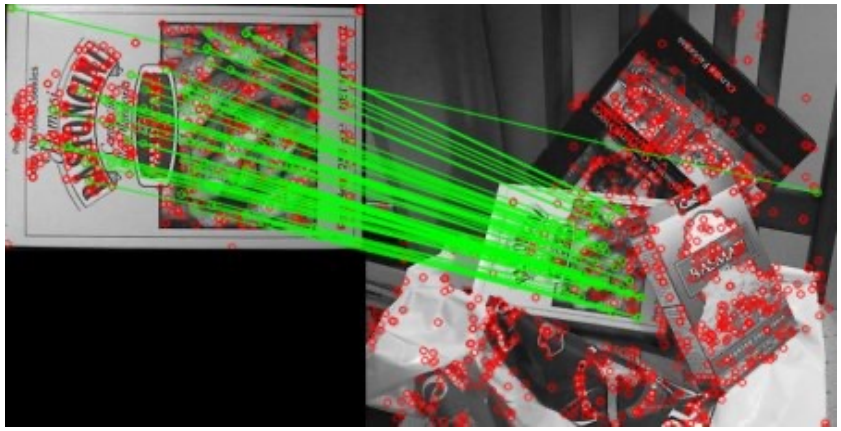
Find Contours in image

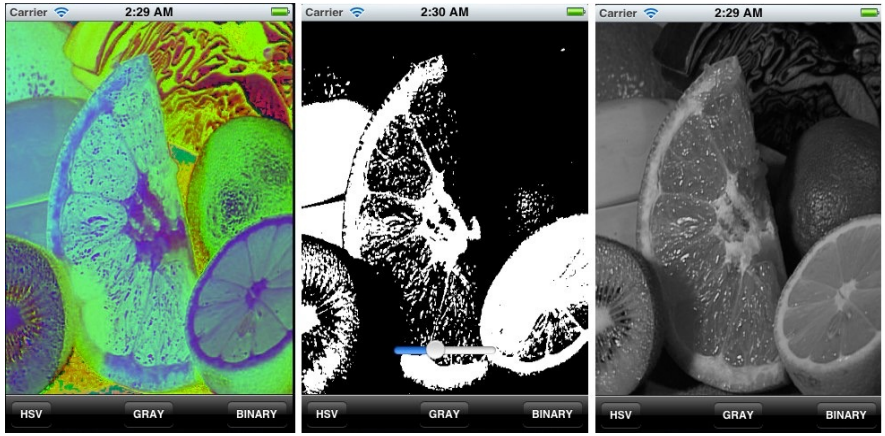


02 – Robot Vision Part 1

OpenCV Library

- **OpenCV** is a *large scale*, *open* library for computer vision (in C++, w/ Python, Java and Matlab interfaces).
- The **OpenCV** framework contains numerous state-of-the art algorithms including *filtering*, *feature extraction and matching, 3D reconstruction, video analysis* and many more.
- **OpenCV** is *cross-platform*, and has been successfully compiled and deployed on Linux, MacOS, Windows, and Android/iOS.
- Website: opencv.org





02 – Robot Vision Part 1

Tutorial #1 Image Processing

Simple module that basically:

- Start off with Where's Wally :-)
- loading an illustration
- performing simple image processing
  - Cropping
  - Blurring
  - Modifying contrast

https://github.com/vvv-school/tutorial_find-wally

02 – Robot Vision Part 1

Tutorial #2 Image Processing

Simple module that basically:

- Track something round and red :-)
- Work on live image streams
- performing simple image processing
  - Spatial Filters (GaussianBlur)
  - Morphology (dilate, erode)
  - Detect Circles (HoughCircles)

https://github.com/vvv-school/tutorial_yarp-opencv

03 – Robot Vision Part 2

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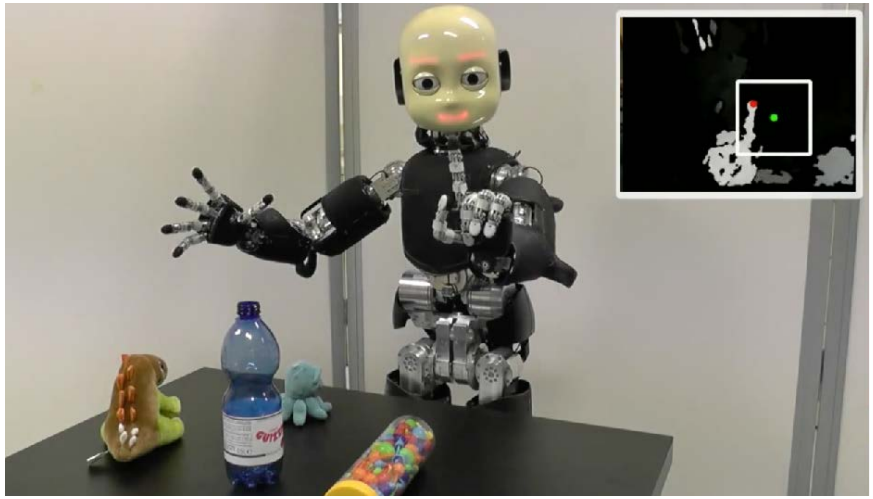

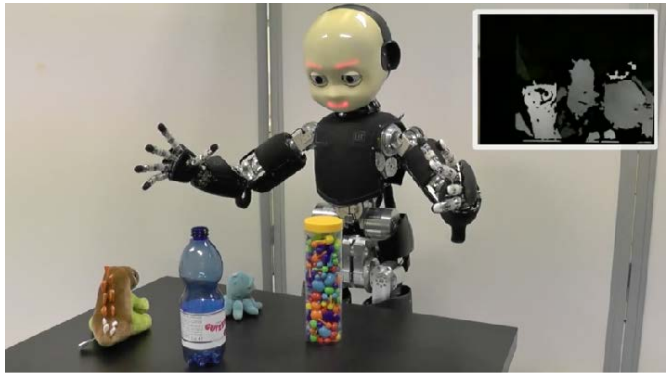

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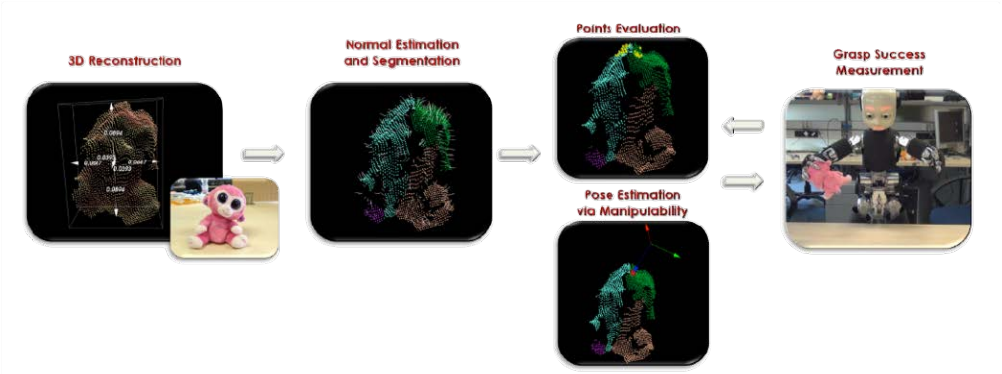

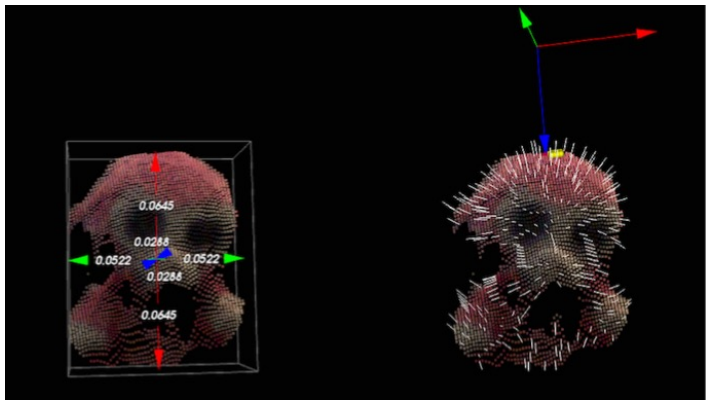

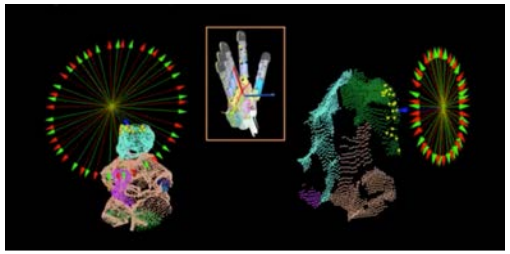

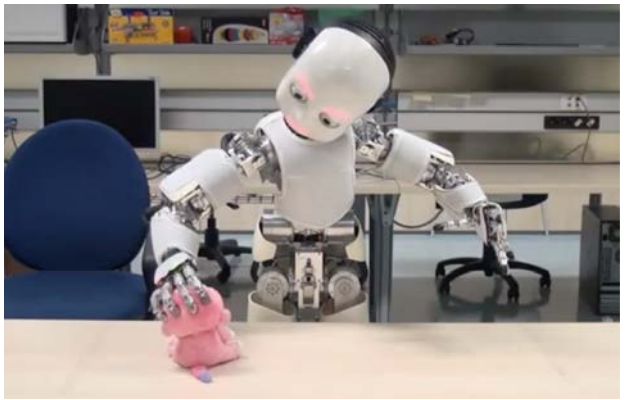

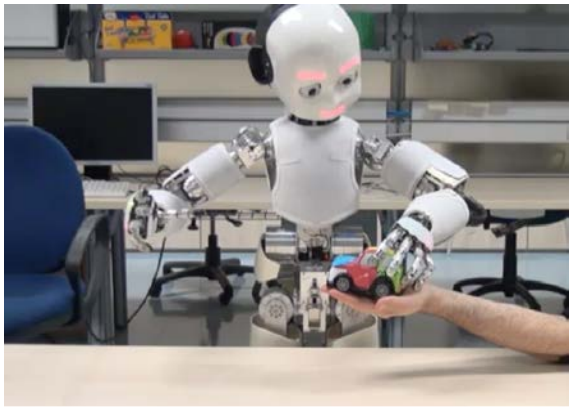

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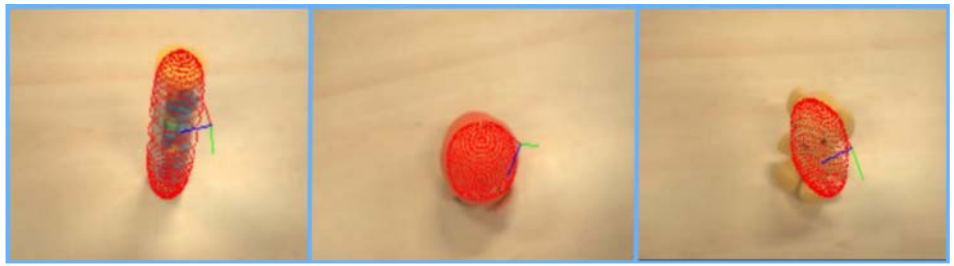

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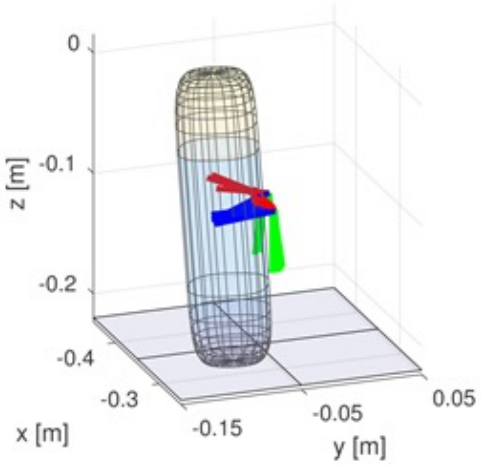

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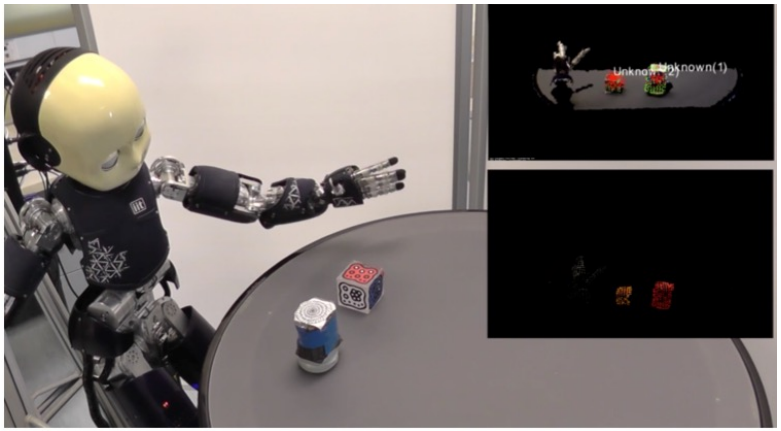

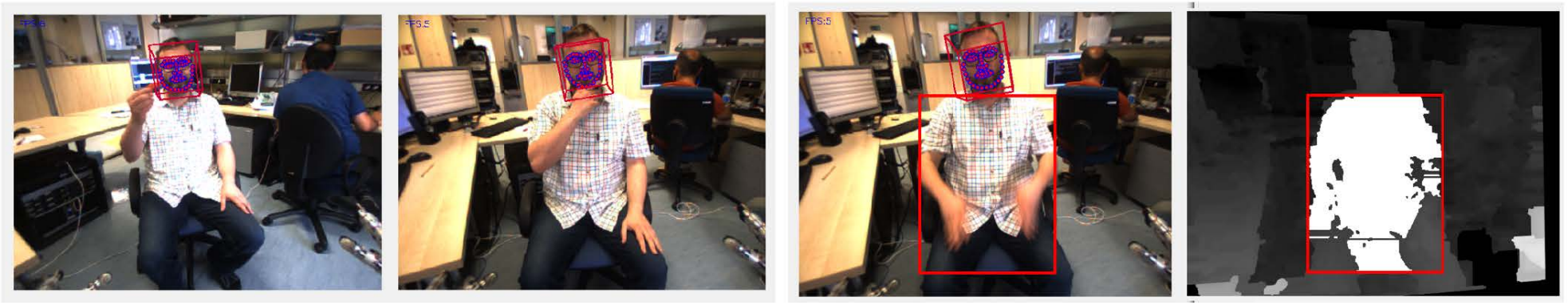

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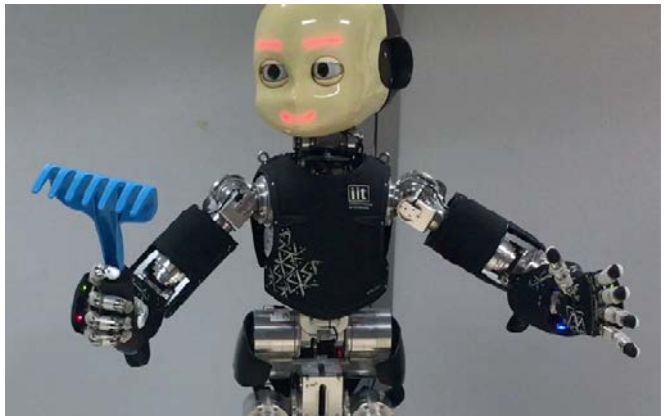

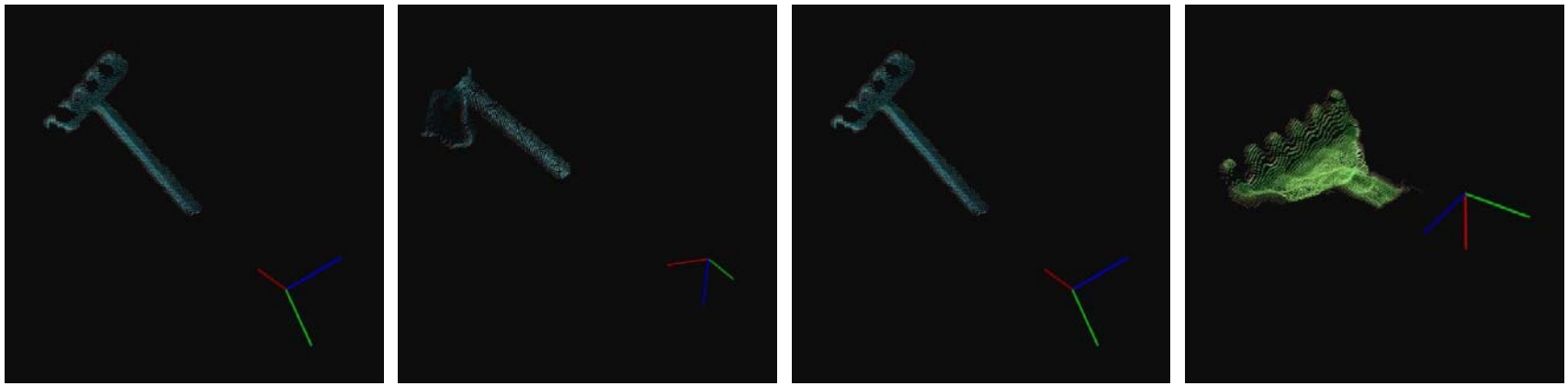

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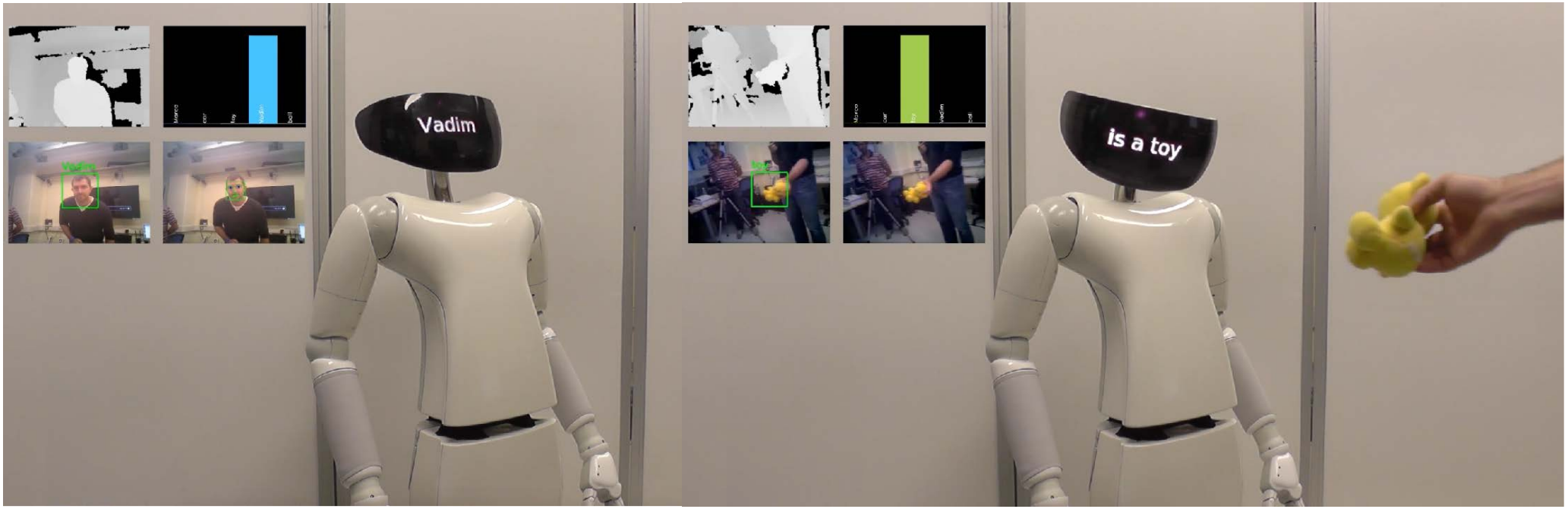

03 – Robot Vision Part 2

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iCub FACILITY

Laboratory for Computational and Statistical Learning
LCSL

Online Learning Object Detection Pipeline for Humanoid Robots

Elisa Maiettini, Vadim Tikhanoff, Giulia Pasquale
Lorenzo Natale, Lorenzo Rosasco

03 – Robot Vision Part 2

03 – Robot Vision Part 2

Assignment Robot Vision

By now, you should be familiar with:

- Getting images from streams
- Smoothing Images
- Eroding and Dilating (Morphology transformation)
- Basic thresholding
- Hough Circle Transform
- Template Matching
- Finding contours in your image
- Image Moments
- Point Polygon Test

Impelment a complex module that:

- Get **streams of images**
- **processing** techniques to make the disparity image cleaner for processing. (GaussianBlur, erode, dilate)
- Retrieve the **maximum value** and its **position**.
- Apply **thresholding** on that point to remove unwanted background
- Find the **contour** of the closest object with its **moment** and **mass center**
- Draw it on the disparity image
- Get its **bounding box** (ROI-Region of Interest)
- Create a **cropped image** containing the **RGB image** of the ROI
- Fill in a **YARP bottle** as a **list**
- Finally, **stream** the resulting **image** out.

https://github.com/vvv-school/assignment_closest-blob

Robot
{vision}