

Humanoid Robots for Education

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Introducing NAO in Education



Robotics : a huge market for the 21st Century



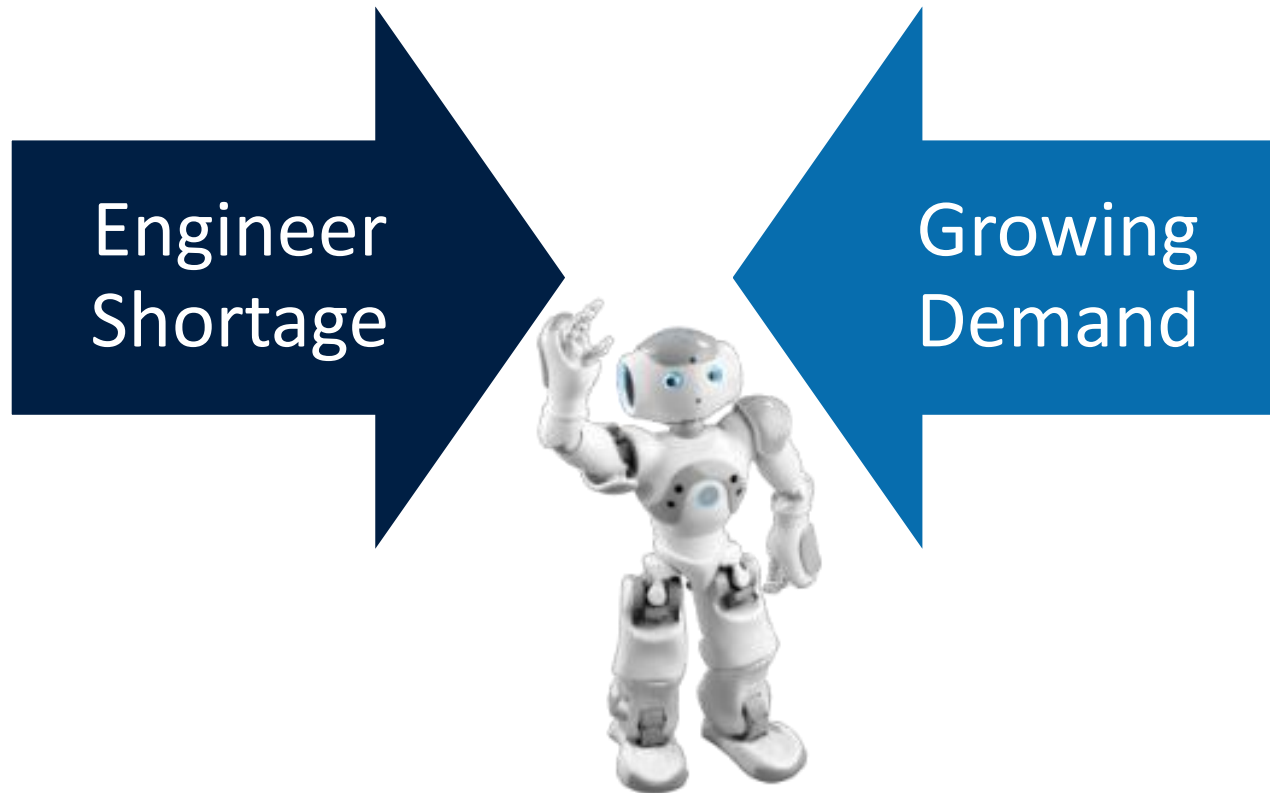
ROBOTS helping the well being of humanity

**Millions of jobs in the countries producing robots
(hardware, software and services)...**

...we need to train the next generation!

Why robots in Education?

A progressive dissatisfaction for scientist discipline
Education & Technology are challenging

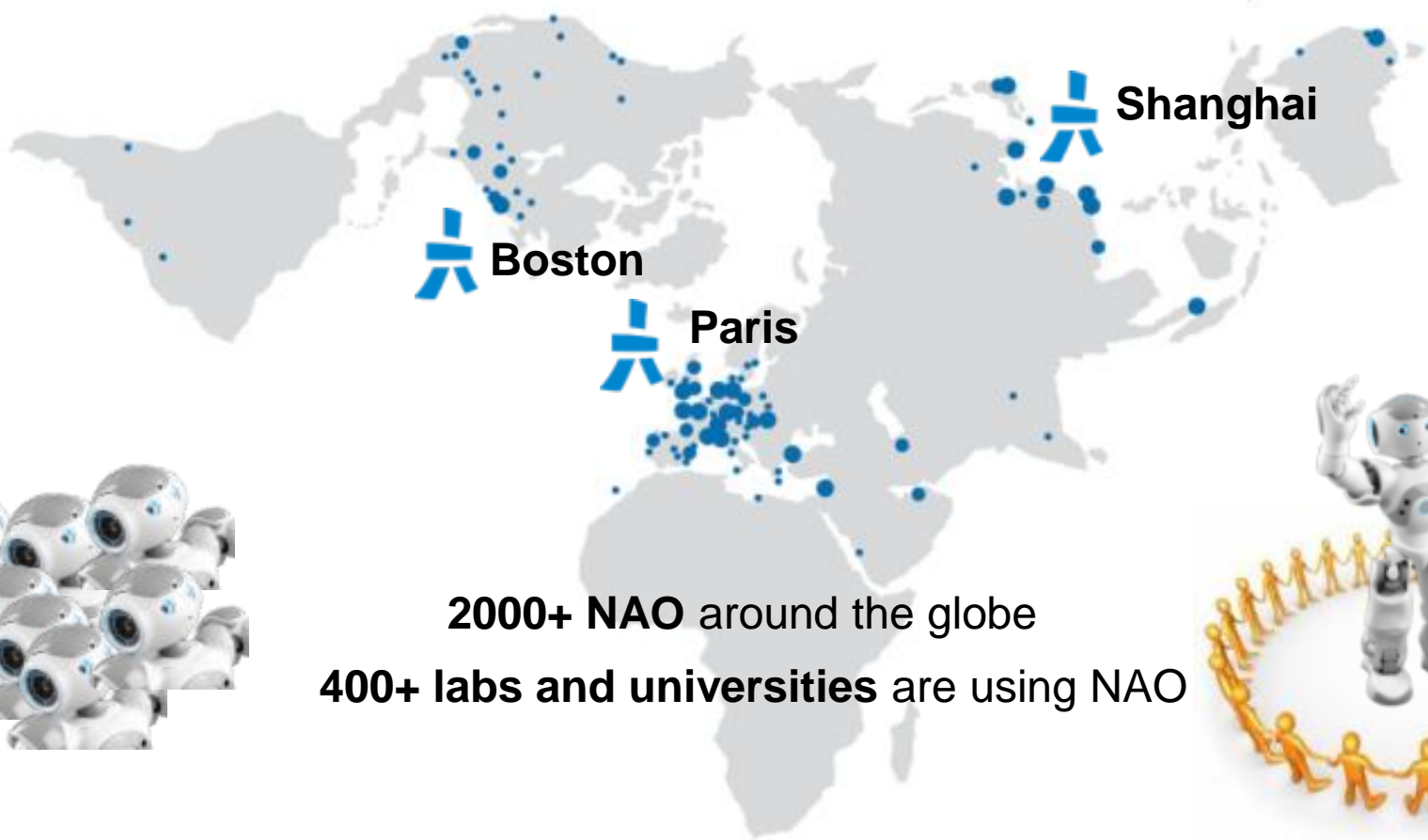


EXPLORE AND ACCESS NEW FIELDS OF RESEARCH
GENERATE AND TRANSMIT KNOWLEDGE
MERGE SUBJECTS

Aldebaran Robotics in a nutshell

A unique team of **130+ employees** :
Engineers, PhDs, Sales & Marketing

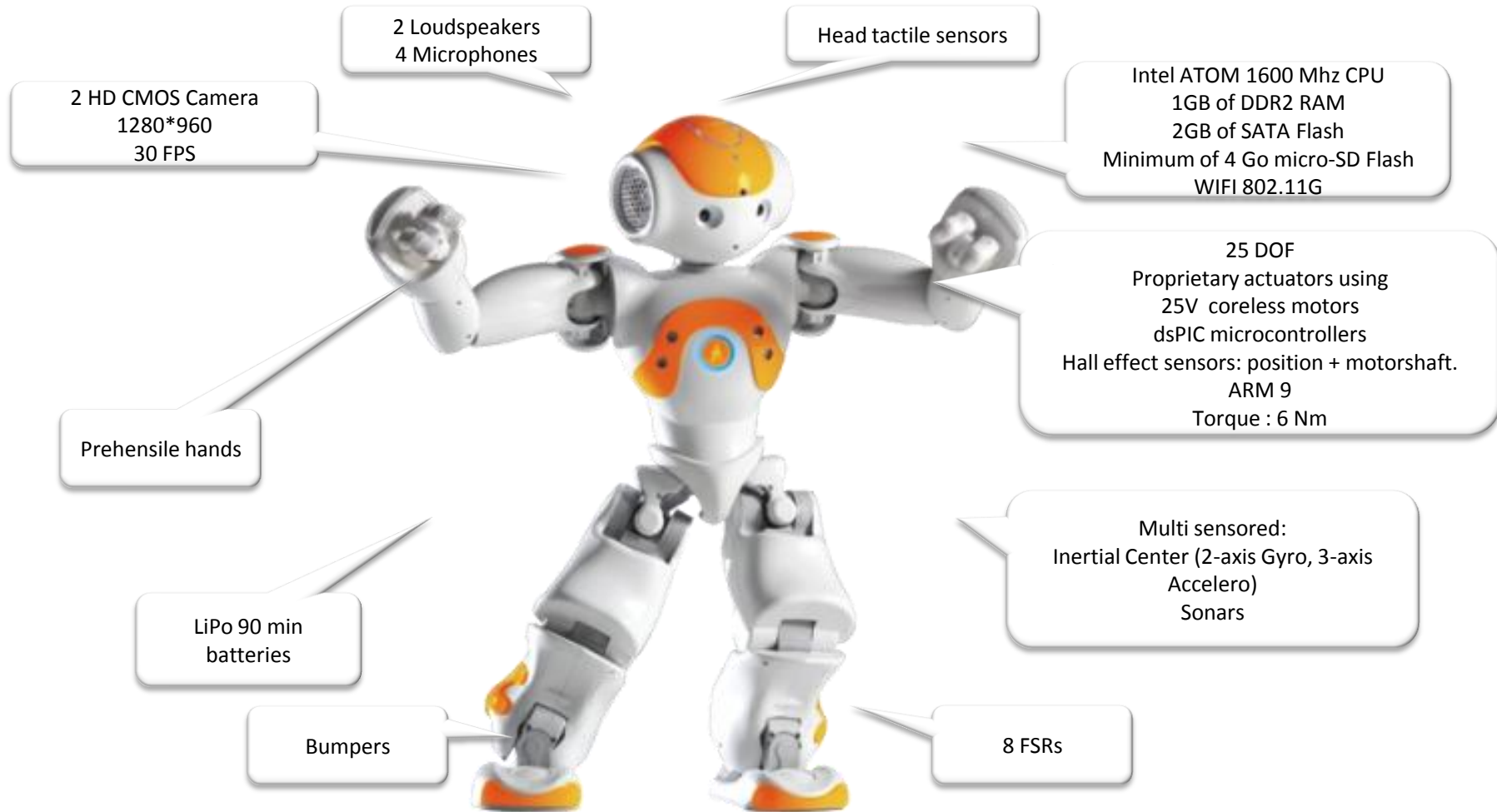
To be closer to our clients
3 offices : Paris, Boston & Shanghai



2000+ NAO around the globe
400+ labs and universities are using NAO



What is Nao ?



Programming : Choregraphe

The image displays the Choregraphe software interface, which is used for programming robots. The main window shows a timeline at the top with keyframes (keyframe16, keyframe31, keyframe50) and a central workspace with a scene graph containing nodes like 'FaceLeds', 'Say', and 'RandomEyes'. A 'Set parameters of Say' dialog box is open, showing parameters for text ('Hello, nice to meet you'), voice shaping (100), and speed (100). A 'Timeline editor' window is also visible, showing a graph of actuator positions (Head, Arms, Legs) over time. On the right, a 3D model of a robot is shown, and a 'Motion' window displays a specific movement sequence. The interface includes a menu bar (File, Edit, Connection, Behaviors, View, Help), a toolbar, and a left sidebar with a 'Box List' and 'File' browser.

Default Project* - Choregraphe

File Edit Connection Behaviors View Help

Motion

Behavior layers

Timeline

Box List

File

default

- Audio
- Params
- Music
- Pronounce
- Record
- Say
- Say Text
- SpeechReco
- Communication
- Leds
 - Ear Light
 - FaceLeds
 - RandomEyes
 - Switch Leds
 - Water Clock
- Logic
- Math
- Movement
 - Dance
 - Hello
 - LieDown
 - Movement

RandomEyes: The eye color changes randomly. Never stopping method. You should call the method to stop it.

FPS: 32.0

Set parameters of Say

Parameters

text: Hello, nice to meet you

Voice Shaping: 100

speed: 100

Auto-update parameters on robot

Reset to default

OK Cancel

Timeline editor

Record

Actuators

- All
 - Head
 - Arms
 - Left arm
 - Right arm
 - Legs
 - Shoulder
 - Left leg
 - Right leg

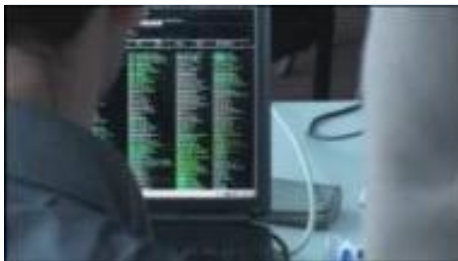
Motion

Enable chain with

NAO in Education

PROGRAMMING

TEAM WORK



COMMUNICATION
SKILLS



SCIENTIFIC
PROCESS

PROJECT
MANAGEMENT



INTERDISCIPLINARY
PROJECTS

ROBOTICS

PHYSICS

MATHEMATICS

SCIENCE

COMPUTER SCIENCE

ENGINEERING

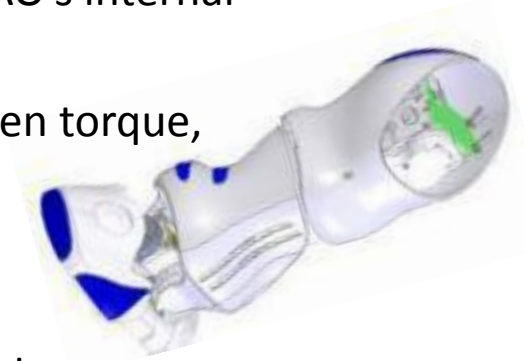
RoboCup: Sport is good for students



Engineering Education with NAO

- Mechanical Engineering

- ❖ Solidworks files of the left arm and right leg to discover NAO's internal conception
- ❖ Explain the concept of Torque and the relationship between torque, power and energy



- Electronics

- ❖ Control & Automatism using our motion APIs or Choregraphe
- ❖ Telepathe to see sensors and motors actions (current variations for instance)

- NAO's architecture

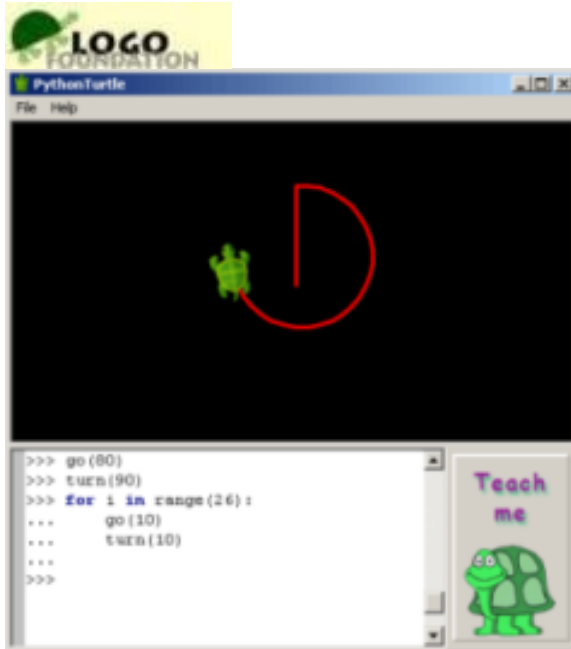
- ❖ Teach how a robot is built using NAO's example: mechanical parts, communication buses, firmware and software framework



Computer Sciences with NAO

- Programming

- ❖ Teach basic programming principles (the NAO-turtle programming) or advanced topics (embedded, task planning and scheduling, real-time)



- Vision & audio processing:

- ❖ Calculate the distance of a human according to the size of the face
- ❖ Create a line follower module
- ❖ Extract the BPM and make Nao dance in rhythm







Social Sciences with NAO

- Game theory in the fields of political science, social psychology, etc.
 - ❖ Teach various forms of strategies, equilibrium or games with NAO as the animator
- Human-robot interaction
 - ❖ How to express body emotions?
 - ❖ How to interact with a human?
 - ❖ How to teach ethics to a robot?



Prisoners' dilemma

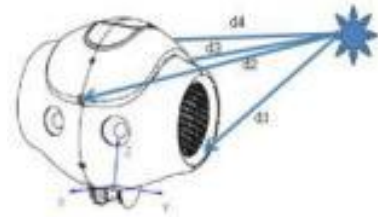
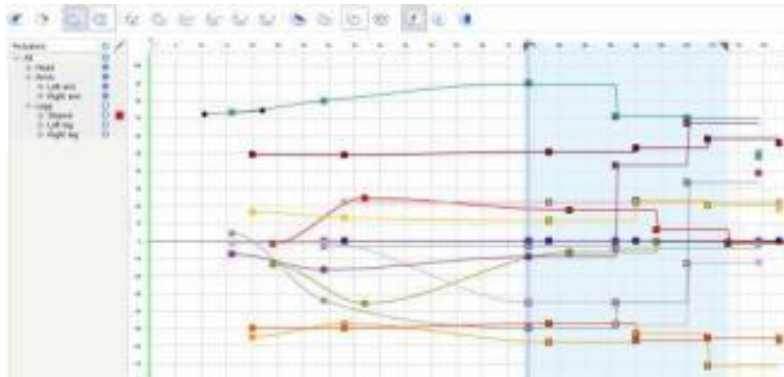
		prisoner B	
		confess	remain silent
prisoner A	confess	 5 years 5 years	 0 year 20 years
	remain silent	 20 years 0 year	 1 year 1 year

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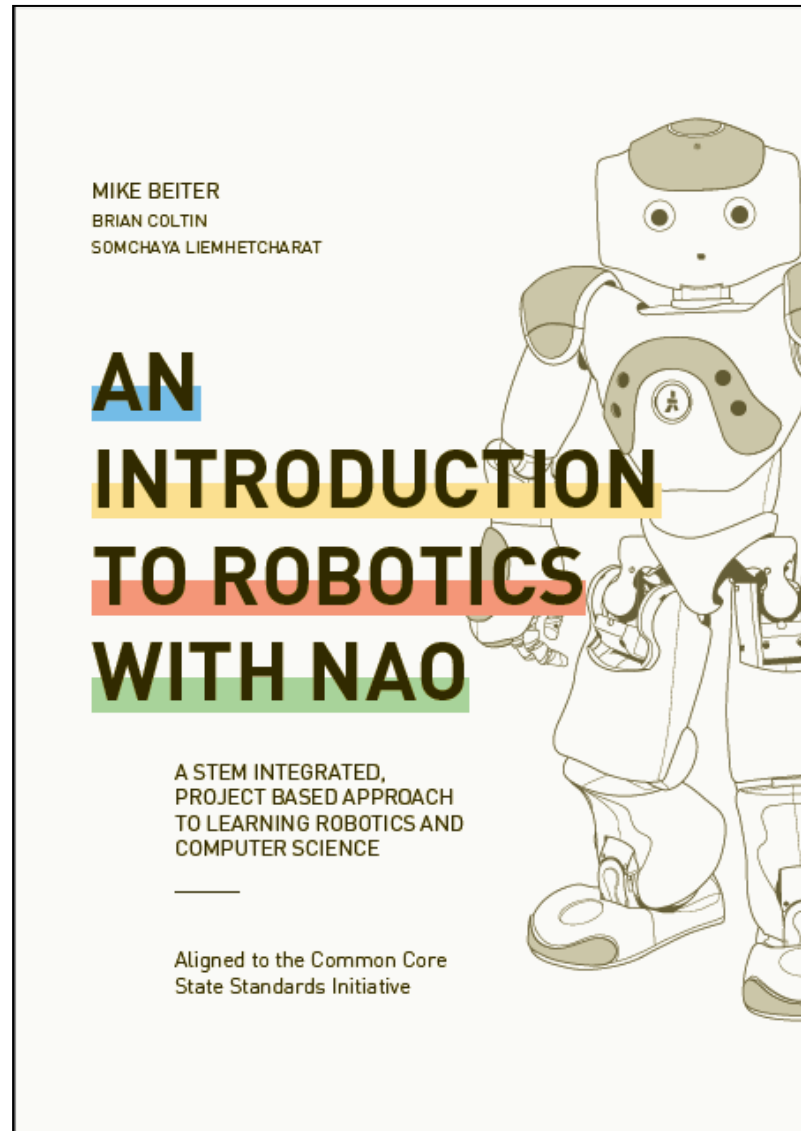


Sciences Education with NAO

- Basic principles of physics
 - ❖ Light spectrum: use NAO's camera to see “invisible” lights
 - ❖ Waves: teach the concepts of diffraction and reflection of ultrasounds waves
- Mathematics
 - ❖ From trigonometry (Sound localization) to vector calculus and Jacobian matrix
 - ❖ Show interpolations in action inside Choregraphe and teach the equations behind.
 - ❖ Game theory : ask your students to implement algorithms (Nash equilibrium for instance) into 2 (or more) NAOs and see the results of the different game theories



Aldebaran proposes a complete curriculum



Education at Home : the RASPO project

- Collaboration

- ❖ Paraschool : Educative Software on PC
- ❖ Lutin Lab : evaluation of pedagogical impact
- ❖ Funded by DGCIS (French Government)

- Serious Gaming for education of children

- ❖ Robot for Personal Scholar support
- ❖ Communication via projected pictures
- ❖ Manipulation of pedagogical objects

- Example of exercises

- ❖ Nao gives the change
- ❖ Computation of double and half of numbers
- ❖ Spelling of words

- Principle

- ❖ The robot comes from another planet
- ❖ The child teaches him how things are working on earth



RASPO : First results

- Projection and interaction on Pictures
- First idea : embedded projector on Nao
 - ❖ Complex mechatronic integration
 - ❖ Low quality of projected picture
 - ❖ Problem with focus and shape
 - ❖ Vision processing required for interaction
- Second idea : use of a remote display (PC or, even better, tablet)
 - ❖ The robot creates a Web page displayed by the tablet
 - ❖ No mechatronic integration
 - ❖ High quality display
 - ❖ Intuitive interaction with the display
 - ❖ To be done : Nao watches the display



Humanoid Robots for Education

- Robots are great for teaching

- ❖ Software
- ❖ Signal processing
- ❖ Control
- ❖ Mathematics
- ❖ Physics



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- Humanoids are even greater

- ❖ More Fun
- ❖ Man Machine Interaction
- ❖ More intuitive understanding of abstract concepts
- ❖ Education becomes edutainment

As you may have already learned from physics class, objects have a center of gravity. An object's center of gravity affects whether its pose is stable. For rigid bodies, the object is stable if the center of gravity lies within the base of the object (see figure below).



For the HAO, the same concept applies. When the HAO is standing on both feet, the base lies between both feet. When the HAO is standing on one foot, the base lies only across that foot. The HAO's center of gravity is approximately located in the torso. Because the HAO can change its "shape" when different parts of its body (arms, legs, head) move, the center of gravity will also shift. You can create complex postures with the HAO while keeping it balanced!

