

Nao®, the ideal partner for research and education in the field of robotics



Fully programmable

Multiple sensors

Onboard computer

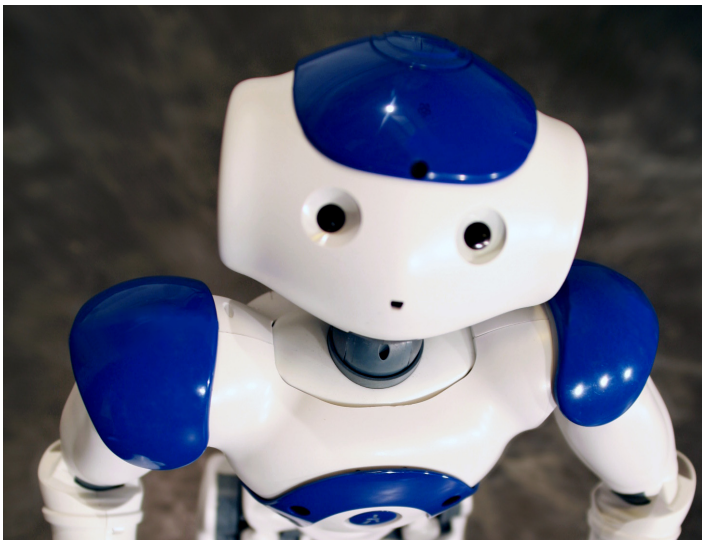
Remote control

Friendly design and lightweight

Nao Academics Edition key features

- 25 Degrees of Freedom
- Two prehensile hands
- x86 AMD Geode 500 Mhz CPU
- 256 MB SDRAM / 1 GB Flash memory
- Wi-Fi 802.11b and ethernet port
- 2x 30 FPS CMOS videocam res. 640x480
- Vision processing capacities
- Two loudspeakers and English vocal synthesis
- Supports multiple programming environments

**NAO**®  
Academics Edition

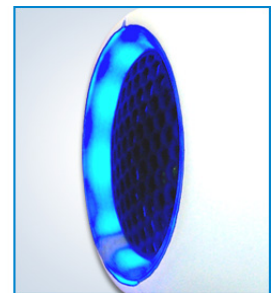
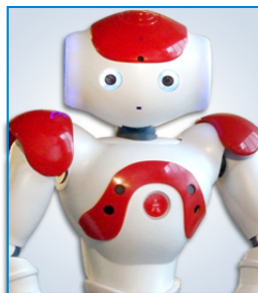
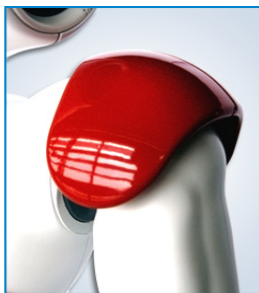


Non contractual photo / Aldebaran Robotics

## A high performance biped robot

After 3 years of research, Aldebaran Robotics™ has developed Nao® a 58 cm (23") tall biped robot. It's a unique combination of hardware and software in a great design.

Nao stands tall in all points amongst its robotic brethren. Platform agnostic, it can be programmed and controlled using Linux, Windows or Mac OS. The hardware has been built from the ground up with the latest technologies providing great fluidity in its movements and offering a wide range of sensors.



Non contractual photo / Aldebaran Robotics

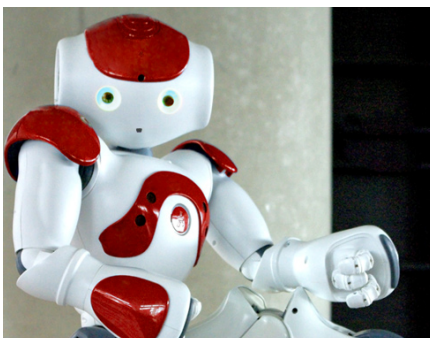
### Movements

It comes with 25 degrees of freedom for great mobility.

The inertial sensor provides great stability while moving and enables positioning within space.

The sonar sensors allow Nao to detect and avoid obstacles.

His state-of-the-art onboard actuators, give Nao extreme precision in its movements.



Non contractual photo / Aldebaran Robotics

### Programming capacities

Nao contains an open framework which allows distributed software modules to interact together seamlessly. Depending on the user's expertise, Nao can be controlled via Choregraphe®, our user friendly behavior editor, by programming C++ modules, or by interacting with a rich API from scripting languages.

In addition to the high level API which allows users to make Nao walk and balance, advanced users can take advantage of low level access to sensors and actuators and can, if they wish, replace our code with custom adaptations.

In order to allow users to validate motion sequences, simulators are available for Microsoft Robotics Studio and Webots.

#### Programming languages *URBI Script, C, C++, Python*

#### Programming Software

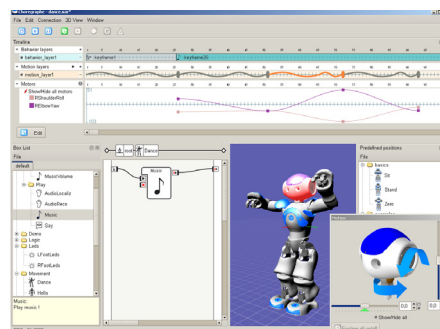
*Aldebaran Choregraphe (included)*  
*Microsoft Robotics Studio (not included)*  
*Cyberbotics Webots (not included)*  
*Gostai Urbi Studio (not included)*

#### Operating Systems

*Linux, Windows XP, Mac OS X*

### Interactions

Nao features embedded software modules allowing text to speech, sound localization, visual pattern and coloured shape detection, obstacle detection (based on the two channel sonar system) and visual effects or communication through the many LEDs.



*The design of Nao® is the property of Aldebaran Robotics.*



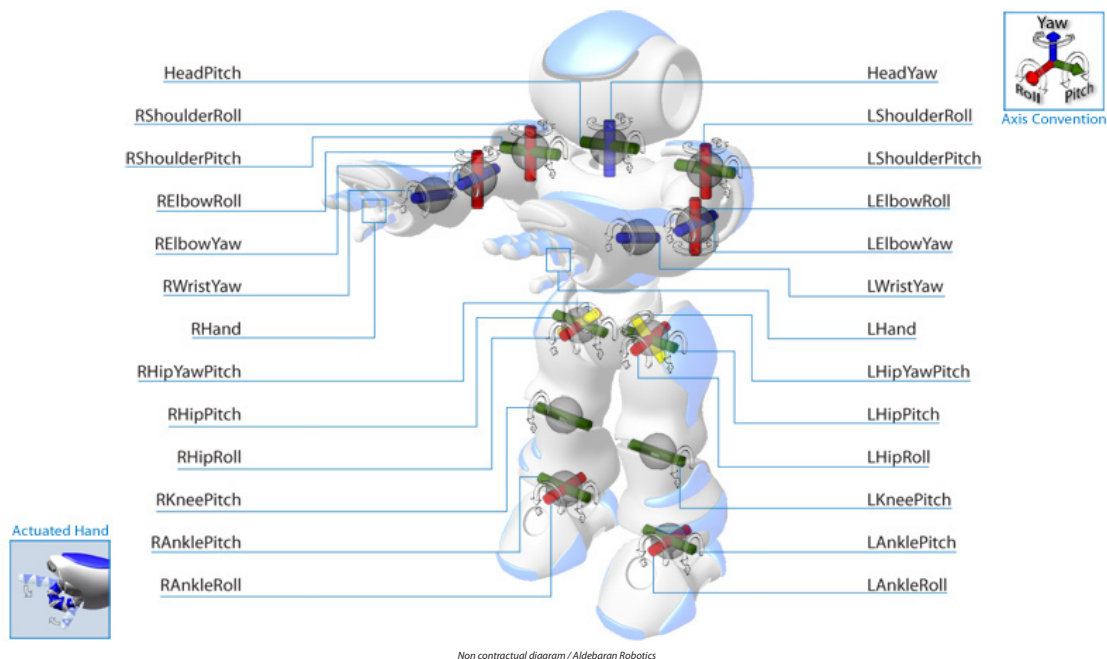
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### Body and multimedia

Nao can be personalised with different colors (red, blue or customized colors...). His integrated multimedia components (Hi-Fi speakers system, microphones system, 2 digital cameras) allow many different capabilities like speech, playing music, localizing sound sources or face detection programs.

## Kinematics

The scheme underneath presents all the robot's axes. Together, these axes allow 25 degrees of freedom, which when coupled with the inertial sensor, the force sensitive resistors, the Hall effect sensors, the infrared receiver and the sonar sensors, allows Nao® a high level of stability and fluidity in its movements.



## Motion range

PART	JOINT NAME	MOTION	RANGE (degrees)
Head	HeadYaw	Head joint twist (Z)	-120 to 120
	HeadPitch	Head joint front & back (Y)	-45 to 45
Left arm	LShoulderPitch	Left shoulder joint front & back (Y)	-120 to 120
	LShoulderRoll	Left shoulder joint right & left (Z)	0 to 95
	LEIbowRoll	Left shoulder joint twist (X)	-120 to 120
	LEIbowYaw	Left elbow joint (Z)	-90 to 90
	LWristYaw	Left wrist joint twist (X)	-105 to 105
	LHand	Left hand	open & close
Left leg	LHipYawPitch	Left hip joint twist (Z45°)	-90 to 0
	LHipPitch	Left hip joint front and back (Y)	-100 to 25
	LHipRoll	Left hip joint right & left (X)	-25 to 45
	LKneePitch	Left knee joint (Y)	0 to 130
	LAnklePitch	Left ankle joint front & back (Y)	-75 to 45
	LAnkleRoll	Left ankle joint right & left (X)	-45 to 25
Right leg	RHipYawPitch	Right hip joint twist (Z45°)	-90 to 0
	RHipPitch	Right hip joint front and back (Y)	-100 to 25
	RHipRoll	Right hip joint right & left (X)	-45 to 25
	RKneePitch	Right knee joint (Y)	0 to 130
	RAnklePitch	Right ankle joint front & back (Y)	-75 to 45
	RAnkleRoll	Right ankle right & left (X)	-25 to 45
Right arm	RShoulderPitch	Right shoulder joint front & back (Y)	-120 to 120
	RShoulderRoll	Right shoulder joint right & left (Z)	-95 to 0
	REIbowRoll	Right shoulder joint twist (X)	-120 to 120
	REIbowYaw	Right elbow joint (Z)	-90 to 90
	RWrist Yaw	Right wrist joint twist (X)	-105 to 105
	RHand	Right hand	open & close

## General characteristics

<b>Body characteristics</b>		<b>Actuators</b>	
Height	~ 58 cm	Aldebaran Robotics™ original design based on:	
Weight	~ 4.3 Kg	<ul style="list-style-type: none"> <li>○ Hall effect sensors</li> <li>○ dsPICs microcontrollers</li> <li>○ Coreless MAXON DC motors</li> </ul>	
Body type	Technical plastic	<b>Sensors</b>	
<b>Energy</b>		Different type	32 x Hall effect sensors 1 x gyro meter 2 axis 1 x accelerometer 3 axis 2 x bumpers 2 channels sonar 2 x I/R Capacitif
Charger	AC 90-230 volts/DC 24 volts	<b>LED</b>	
Battery capacity	~ 45 min. autonomy	Eyes	2 x 8 LED RGB Fullcolor
<b>Degrees of freedom</b>		Ears	2 x 10 LED 16 Blue levels
Head	2 DOF	Torso	1 LED RGB Fullcolour
Arm	5 DOF in each arm	Feet	2 x 1 LED RGB Fullcolour
Pelvis	1 DOF	<b>Motherboard</b>	
Leg	5 DOF in each leg	- x86 AMD GEODE 500MHz CPU - 256 MB SDRAM / 1 GB flash memory	
Hand	1 DOF in each hand	<b>Embedded Software</b>	
<b>Multimedia</b>		OS	- Embedded Linux (32 bit x86 ELF) using custom OpenEmbedded based distribution
Speakers	2 Loudspeakers	Programming languages	- C, C++, Urbi script
Microphones	4 Microphones		
Vision	2 CMOS digital cameras		
<b>Network access</b>			
Connections type	- Wi-Fi (IEEE 802.11g) - Ethernet connection		

## Motors specifications

Nao® is equipped with two different motor types with the following characteristics:

<b>Motor Type 1</b>		<b>Motor Type 2</b>	
No Load Speed	8000 RPM	NoLoad Speed	11900 RPM
Stall Torque	59.5 mNm	Stall Torque	15.1 mNm
Nominal Speed	6330 RPM	Nominal Speed	8810 RPM
Nominal Torque	12.3 mNm	Nominal Torque	3.84 mNm
<b>Reduction ratio type 1</b>	201.3	<b>Reduction ratio Type 1</b>	150.27
No Load Speed	238.45 °/s (4.76°/20ms)	No Load Speed	473.72 °/s (9.47°/20ms)
Stall Torque	11.97 Nm (without the ratio efficiency)	Stall Torque	2.27 Nm (without the ratio efficiency)
Nominal Speed	188.67 °/s (3.77°/20ms)	Nominal Speed	351.77 °/s (7.03°/20ms)
Nominal Torque	2.47 Nm (without the ratio efficiency)	Nominal Torque	0.57 Nm (without the ratio efficiency)
<b>Reduction ratio type 2</b>	130.85	<b>Reduction ratio Type 2</b>	173.22
No Load Speed	366.83 °/s (7.33°/20ms)	No Load Speed	412.19 °/s (8.24°/20ms)
Stall Torque	7.78 Nm (without the ratio efficiency)	Stall Torque	2.61 Nm (without the ratio efficiency)
Nominal Speed	290.25 °/s (5.80°/20ms)	Nominal Speed	305.16 °/s (6.10°/20ms)
Nominal Torque	1.61 Nm (without the ratio efficiency)	Nominal Torque	0.66 Nm (without the ratio efficiency)

*All specifications are not contractual and are subject to change.*



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