NAO

ACADEMICS EDITION

NAO®, THE IDEAL PARTNER FOR RESEARCH AND EDUCATION IN THE FIELD OF ROBOTICS

Fully programmable

Multiple sensors

Onboard computer

Remote control

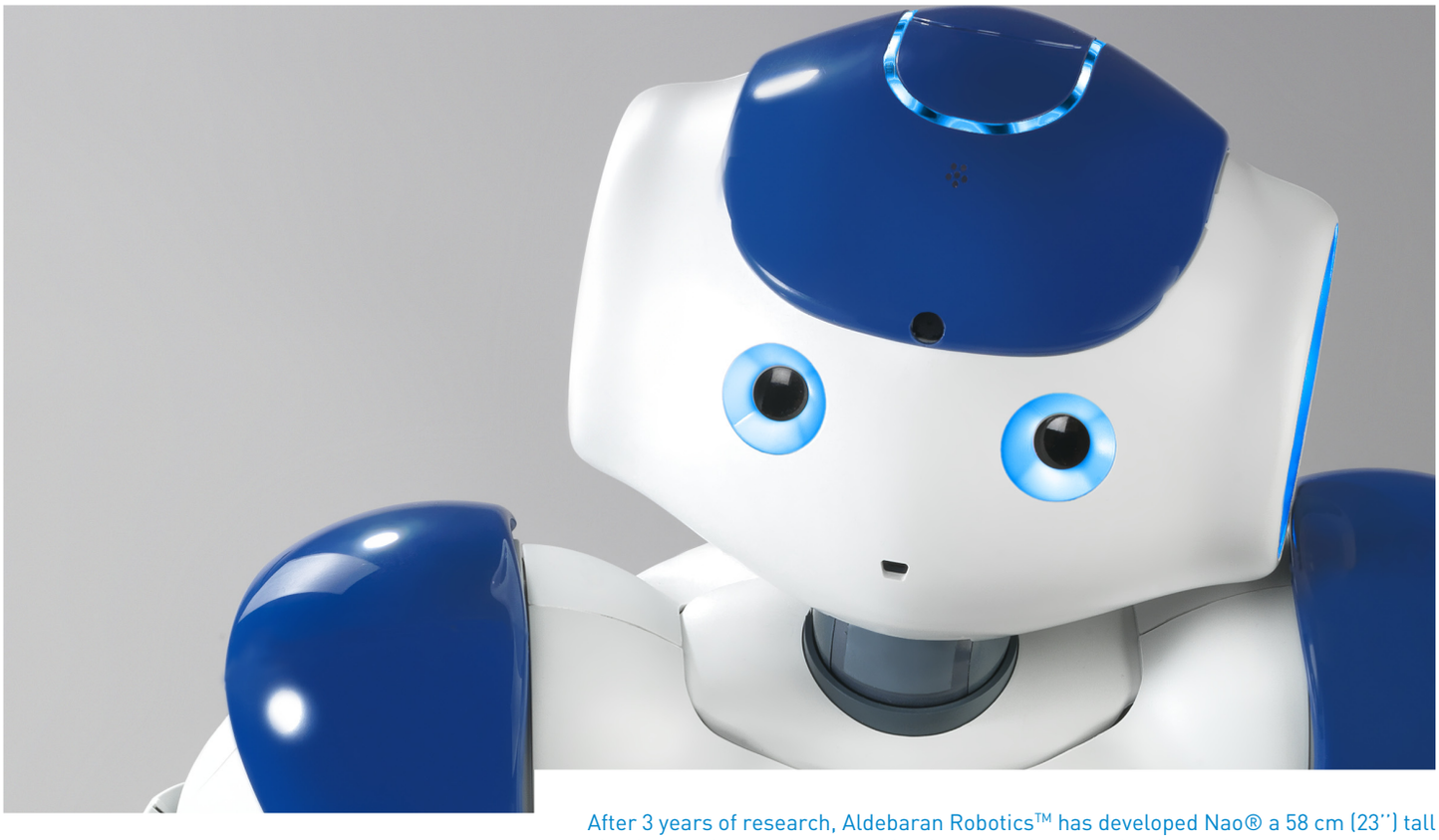
Friendly design and lightweight

Nao Academics Edition key features

- 25 Degrees of Freedom
- Two prehensile hands
- x86 AMD Geode 500 Mhz CPU
- 256 MB SDRAM / 2 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

Comes with software and complete documentation

ALDEBARAN Robotics



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. 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. Platform agnostic, it can be programmed and controlled using Linux, Windows or Mac OS and comes with complete software and documentation.

All-in-one humanoid robot

MOVEMENT

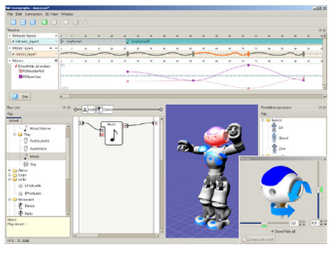
Nao comes with 25 degrees of freedom for great mobility. The inertial sensor provides great stability while moving and enables positioning within space. Sonars and FSRs allow Nao to detect its environment and to navigate seamlessly.

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

INTERACTION

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.

PROGRAMMING



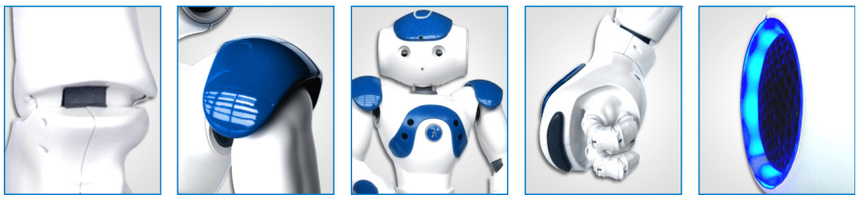
Nao contains an open framework which allows distributed software modules to interact together seamlessly. Depending on the user's expertise, Nao can be controlled via Choregraphe®, our user friendly behavior editor, by programming C++ modules, or by interacting with a rich API from scripting languages.

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.

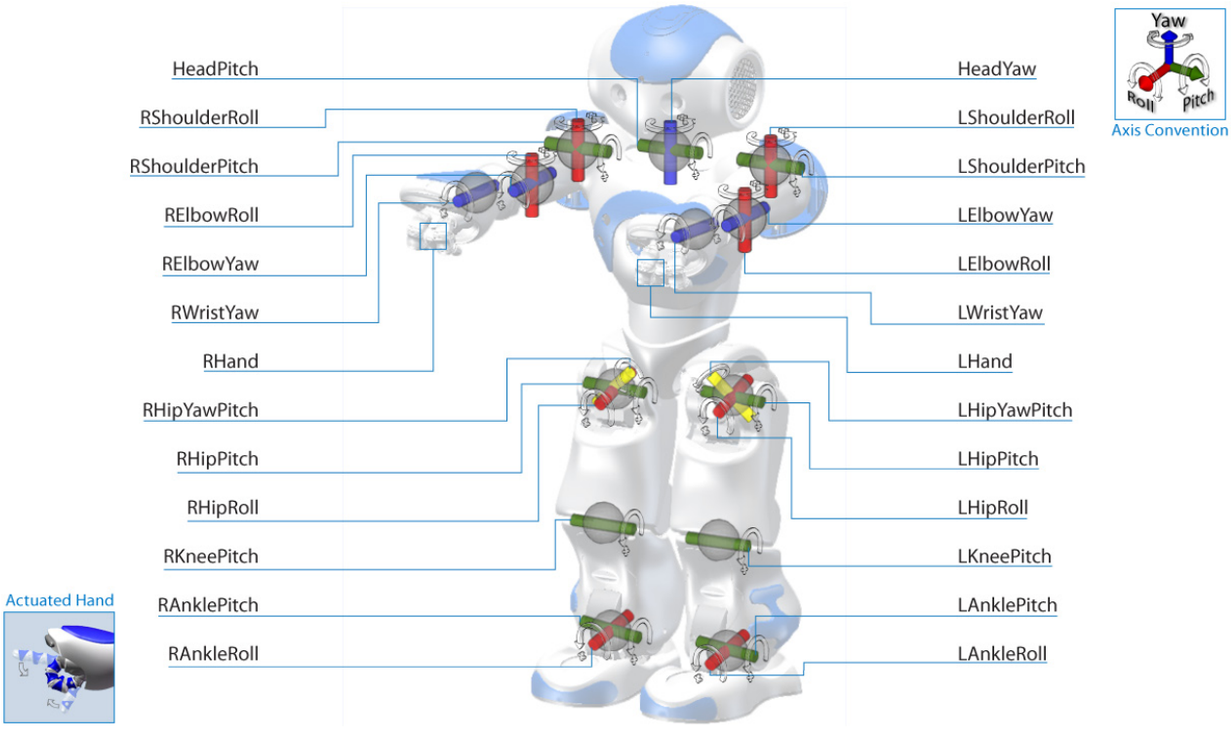
BODY AND MULTIMEDIA

Nao can be personalized 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.



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

Kinematics



The scheme above 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)	-39 / 30
Left arm	LShoulderPitch	Left shoulder joint front & back (Y)	-120 to 120
	LShoulderRoll	Left shoulder joint right & left (Z)	0 to 95
	LElbowRoll	Left shoulder joint twist (X)	-90 / 0
	LElbowYaw	Left elbow joint (Z)	-120 / 120
	LWristYaw	Left wrist joint twist (X)	-105 to 105
	LHand	Left hand	open & close
Left leg	LHipYawPitch	Left hip joint twist (Z45°)	-44 / 68
	LHipPitch	Left hip joint front and back (Y)	-104.5 / 28.5
	LHipRoll	Left hip joint right & left (X)	-25 to 45
	LKneePitch	Left knee joint (Y)	-5 / 125
	LAnklePitch	Left ankle joint front & back (Y)	-70.5 / 54
	LAnkleRoll	Left ankle joint right & left (X)	-45 to 25
Right leg	RHipYawPitch	Right hip joint twist (Z45°)	-68 / 44
	RHipPitch	Right hip joint front and back (Y)	-104.5 / 28.5
	RHipRoll	Right hip joint right & left (X)	-45 to 25
	RKneePitch	Right knee joint (Y)	-5 / 125
	RAnklePitch	Right ankle joint front & back (Y)	-70.5 / 54
	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
	RElbowRoll	Right shoulder joint twist (X)	0 / 90
	RElbowYaw	Right elbow joint (Z)	-120 / 120
	RWrist Yaw	Right wrist joint twist (X)	-105 to 105
	RHand	Right hand	open & close

General characteristics

Body caracteristics	
Height	~ 58 cm
Weight	~ 4.3 Kg
Body type	Technical plastic
Energy	
Charger	AC 90-230 volts/DC 24 volts
Battery capacity	~ 90 min. autonomy
Degrees of freedom	
Head	2 DOF
Arm	5 DOF in each arm
Pelvis	1 DOF
Leg	5 DOF in each leg
Hand	1 DOF in each hand
Multimedia	
Speakers	2 Loudspeakers
Microphones	4 Microphones
Vision	2 CMOS digital cameras
Network access	
Connections type	Wi-Fi (IEE 802.11g)
	Ethernet connection

Actuators	
Aldebaran Robotics™ original design based on:	Hall effect sensors
	dsPICS microcontrollers
	Coreless MAXON DC motors
Sensors	
Different type	32 x Hall effect sensors
	1 x gyrometer 2 axis
	1 x accelerometer 3 axis
	2 x bumpers
	2 channel sonar
	2 x I/R
	Tactile sensor
LED	
Tactile sensor	12 LED 16 Blue levels
Eyes	2 x 8 LED RGB Fullcolour
Ears	2 x 10 LED 16 Blue levels
Torso	1 LED RGB Fullcolour
Feet	2 x 1 LED RGB Fullcolour
Motherboard	
x86 AMD GEODE 500MHz CPU	256 MB SDRAM / 2 GB flash memory
Embedded Software	
OS	Embedded Linux (32 bit x86 ELF) using custom OpenEmbedded based distribution
Programming languages	C, C++, Urbi script, Python

Motor specifications

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

Motor Type 1	
No Load Speed	8000 RPM
Stall Torque	59.5 mNm
Nominal Speed	6330 RPM
Nominal Torque	12.3 mNm
Reduction ratio type 1	**201,3**
No Load Speed	238.45 °/s (4.76°/20ms)
Stall Torque	11.97 Nm (without the ratio efficiency)
Nominal Speed	188.67 °/s (3.77°/20ms)
Nominal Torque	2.47 Nm (without the ratio efficiency)
Reduction ratio type 2	**130,85**
No Load Speed	366.83 °/s (7.33°/20ms)
Stall Torque	7.78 Nm (without the ratio efficiency)
Nominal Speed	290.25 °/s (5.80°/20ms)
Nominal Torque	1.61 Nm (without the ratio efficiency)

Motor Type 2	
No Load Speed	11900 RPM
Stall Torque	15.1 mNm
Nominal Speed	8810 RPM
Nominal Torque	3.84 mNm
Reduction ratio type 1	**150,27**
No Load Speed	473.72 °/s (9.47°/20ms)
Stall Torque	2.27 Nm (without the ratio efficiency)
Nominal Speed	351.77 °/s (7.03°/20ms)
Nominal Torque	0.57 Nm (without the ratio efficiency)
Reduction ratio type 2	**173,22**
No Load Speed	412.19 °/s (8.24°/20ms)
Stall Torque	2.61 Nm (without the ratio efficiency)
Nominal Speed	305.16 °/s (6.10°/20ms)
Nominal Torque	0.66 Nm (without the ratio efficiency)

All specifications are not contractual and are subject to change.

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