ALDEBARAN Robotics

Nao®, The new Robocup standard league platform.

Compact and lightweight humanoids

Fully programmable & easy to operate

Bipedal architecture with 21 DOF

Multiple sensors

Programming capacities and remote control

x86 AMD Geode 500 Mhz CPU

256 Mo SDRAM / 1 Gb Flash memory

Wifi 802.11g and ethernet port

30 FPS CMOS videocam res. 640x480

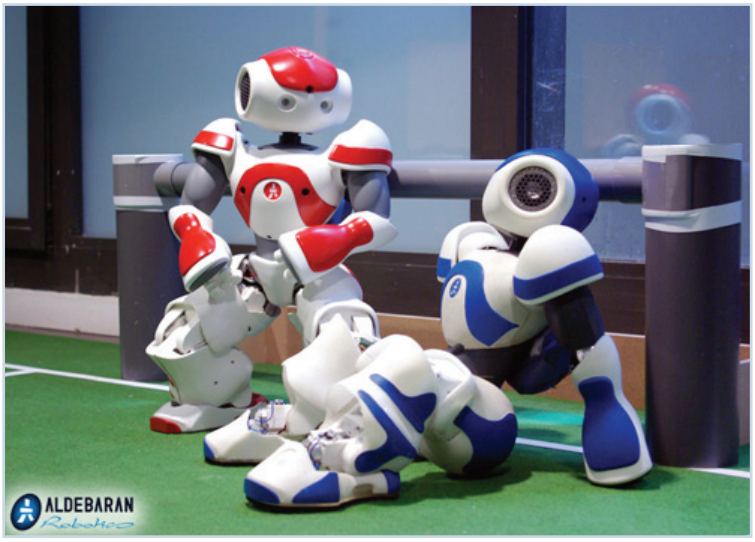
Vision processing capacities

Two loudspeakers and english vocal synthesis

Friendly design and optional colours

NAO
Robocup Edition

Technical specification for Robocup edition only



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A high performance biped robot.

Nao® stands tall in all points amongst its robotic brethren : this unique robot can be controlled and programmed using linux, windows and Mac OS. Nao® can produce very precise movements with fluidity and dynamism. This concentration of high technology can be throughly customised to your specific needs. With its fonctionnality, its flexibility, and its communication system, this robot will satisfy both professional and home users

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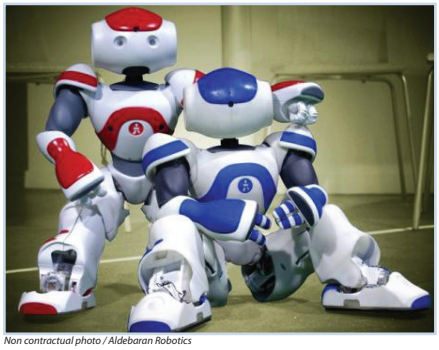
With Nao®, a new stage has been reached

This robot is the fruit of Aldebaran Robotics ingeneering team's intensive research, and goes on the spirit of the objectives defined by the Dr Hiroaki Kitano, funder of the Robocup competition.
With the planned confrontation between human and robots set for 2050, Nao®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brings a biped to the Standard League for the first time.

Nao® will allow teams to program multiple strategies in order to make passes, to find good attacks and to choose the right speed and angle needed to score.

Movements

The 21 degrees of freedom allow Nao to have a great mobility in its environnement.

The inertial unit combined with the FSRs located under each foot gives the robot great stability.

The sonar sensors enables Nao® to avoid obstacles.

His revolutionary proprietary actuators, gives Nao extreme precision in its movements.

Programming capacities

The computer architecture is based on Linux (Linux 32 bit x86 ELF; using a custom OpenEmbedded based distribution with a real-time patched 2.6.22.9 kernel, and gcc-4) and a modular system allowing the user, depending on their expertise, to control Nao® at different levels : either programming in C++ or URBI (or other script languages), or optionaly through Choregraphe, our user friendly motion editor, simple simulator and graphical programming interface.

Besides these possibilities, robocuppers will get an API with low level access to sensors and actuators, and can, if they wish, replace our code with custom adaptations.

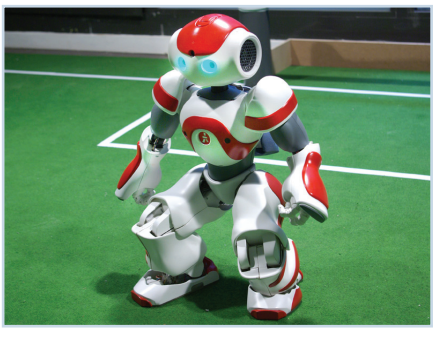
Finally, a free simulator based on Webots/Urbi is provided, specifically adapted to robocuppers.

Interactions

Nao® has embeded software modules allowing text to speech, sound localization, visual pattern and colouredshape detection, obstacle detection (based on the two chanel sonar system) and visual effects or communication through the many LEDs.

Body and multimedia

Nao® can be personnalised with different colors (red, blue or customized colours...). Integrated multimedia components (Hi-Fi speaker system, microphone, video camera) allows many different possibilities like adding voice and face recognition programs or playing music.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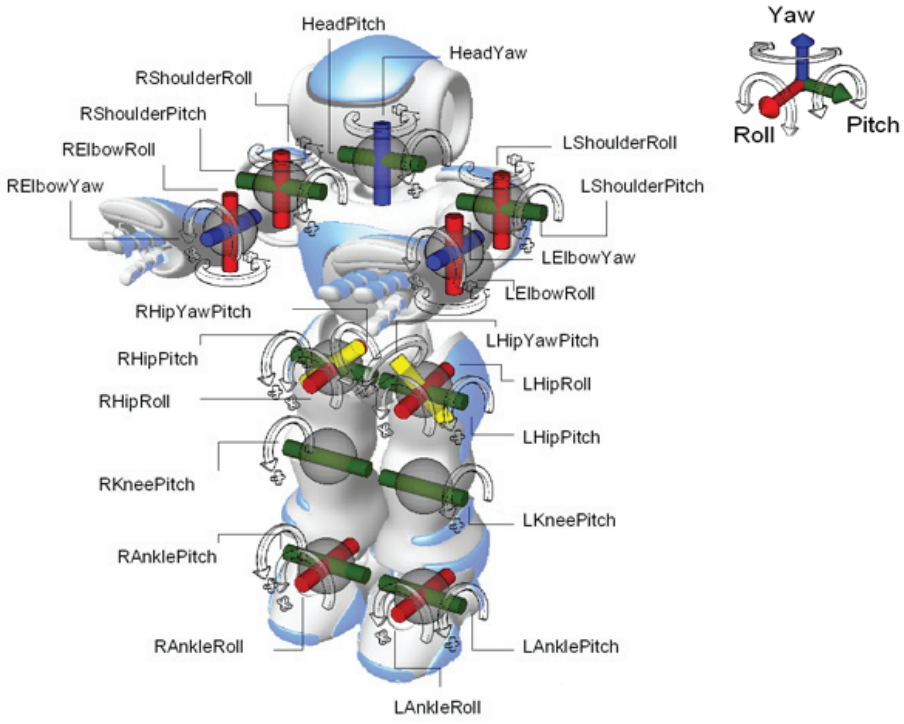
Kinematics

The scheme underneath presents all the robot's axes. Together, these axes allow 21 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 displacements.



Non contractual diagram / Aldebaran Robotics

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
	LElbowRoll	Left shoulder joint twist (X)	-120 to 120
	LElbowYaw	Left elbow joint (Z)	0 to 90
Left leg	LHipYawPitch	Left hip joint twist (Z45°)	-90 to 0
	LHipPitch	Left hip joint front & back (Y)	-100 to 25
	LHipRoll	Left hip joint right and 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
	RElbowRoll	Right shoulder joint twist (X)	-120 to 120
	RElbowYaw	Right elbow joint (Z)	-90 to 0

General caracteristics

Body caracteristics

Height	~ 57 cm
Weight	~ 4.5 Kgs
Body type	Technical plastic

Energy

Battery type	Lithium-ion
Charger	AC 90-230 volts/DC 24 volts adapter
Battery capacity	55 Wh (~45 min. autonomy)

Degrees of freedom

Head	2 DOF
Arms	4 DOF in each arm
Pelvis	1 DOF
Leg	5 DOF in each leg

Audio

Speakers	2 Loudspeakers
Microphones	2 Microphones

Network access

Connections type	- Wifi (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 8 x FSR 2 x gyro meters 3 x accelerometers 2 x bumpers 2 channels sonar

LED

Eyes	2 x 8 LED RGB Fullcolor
Ears	2 x 10 LED 16 Blue levels
Torso	1 LED RGB Fullcolour
Feet	2 x 1 LED RGB Fullcolour

Mother board

- x86 AMD GEODE 500MHz CPU
- 256 Mo SDRAM / 1 Go flash memory

Software

OS	- Embedded Linux (32 bit x86 ELF) using custom OpenEmbedded based distribution
Programming	- URBI, C, C++

Motors data sheet

Nao® is equiped with two different motors types with the followings caracteristics :

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

NoLoad 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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