TIAGo®
TECHNICAL SPECIFICATIONS

GENERAL FEATURES

Height	**Weight**	**Footprint**
110 - 145 cm	70 kg	Ø54 cm

DEGREES OF FREEDOM (DoF)

Torso Lift	**Mobile Base**	**Arm (0/2X)**	**Head**
1	2	7	2

Build your own TIAGo

LITE

TIAGo®

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	LITE	TIAGo	++
Differential drive	✓	✓	✓
Omnidirectional drive	Optional	Optional	Optional
Navigation laser	5.6 m *(upgradable to 10 m, 25 m)*	5.6 m *(upgradable to 10 m, 25 m)*	5.6 m *(upgradable to 10 m, 25 m)*
Lifting torso	✓	✓	✓
Pan-tilt head	✓	✓	✓
7 DoF arm	—	1	2
Default end-effector	—	Parallel Gripper	Parallel Gripper
Force/Torque sensor	—	Optional	Optional
Touchscreen monitor	Optional	—	Optional

* Upgrade kits available in order to evolve your version. The robot's configuration may change without previous notice

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BODY	**Arm payload** (at full extension)	3kg (without end-effector)
	Arm reach	87 cm (without end-effector)
	Torso lift	35 cm
MOBILE BASE	**Drive**	Differential / Omnidirectional (optional)
	Max. speed	1.5 m/s
	Operational environment	Indoor
CONNECTIVITY	**Wireless connectivity**	802.11ax Wi-Fi 6
		Bluetooth 4.0
ELECTRICAL FEATURES	**Battery 36V 20Ah**	1 battery / 2 batteries
	Battery autonomy	4 - 5 h / 8 - 10 h
SENSORS	**Base**	Laser 5.6 m / 10 m / 25 m range, rear sonars 3x1m range
	IMU (Base)	6DoF
	Motors	Actuators current feedback
	Head	RGB-D camera
AUDIO	**Speakers**	2 x 5 W audio speaker
	Microphone	2x microphone array with stereo output 50-8000Hz
COMPUTER	**CPU**	Intel i5 / i7
	RAM	8 GB / 16 GB
	SSD	250 GB / 500 GB
SOFTWARE	**OS**	Ubuntu LTS 64-bits, RT Preempt
	Open source middleware	ROS LTS
	Periodic update/patches	✓
	Arm control mode	Position / velocity / effort control
SUPPORT	**Training and maintenance**	On demand
	Online helpdesk	✓
EXTENSIBILITY	**Laptop tray**	✓
	Mounting points	On head, laptop tray and mobile base
	USB ports	1x USB 3.0, 1x USB 2.0
	Ethernet ports	2x GbE (Gigabit Ethernet)
	Power suppply	12 V / 5 A
	Service panel	HDMI, USB 3.0
OPTIONALS	**End-effector**	Hey5 Hand / PAL gripper / Robotiq™ 2F 85 / 140 / EPick / Your own
	Wrist sensor	6 axis Force/Torque sensor
	Dock station	✓
	Touchscreen	✓
	AI Kit	NVIDIA® Jetson™ TX2 Add-on
	End-effector Camera	Endoscopic

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CORE SOFTWARE

CORE SOFTWARE	Operating system	Ubuntu LTS 64-bit
		RT Preempt RT framework
	Middleware	Orocos
		Robot Operating System (ROS) LTS
USER INTERFACES	Web Commander	Diagnosis of software, actuators and sensors
		Text-to-speech triggering
		Execution of pre-recorded motions
		Execution of demonstrations
	Joystick teleoperation	Mobile base control
		Head control
		Torso lift control
		Execution of pre-recorded motions
NAVIGATION	Core Navigation package	Laser based self-localization and mapping (SLAM)
		Navigation to a point of a map
		Obstacle avoidance using laser sensors
		Available RViZ Plugin to navigation to a point in a map
HUMAN-ROBOT INTERACTION	Text-to-speech	TTS software with one language and one voice
		Triggered via Web-Based robot interface
	Robot Sensor visualization	Available RViZ Plugins for camera, lasers and sonars
		Available RViZ Plugins for IMU and Force/Torque sensors

CONTROL	**ros_control**	Full ros_control compatibility
		Hardware-agnostic controller written as ros_control plugins
		Point level control in position, velocity and effort
		Supported hardware interfaces: position and effort
	ros_controllers	**Joint trajectory controller (default):**
		Command joint-wise trajectories to groups of joints
		(arm, head and torso)
	Default stack of controllers	Command individual joints
		Available QT-based GUI
		Gravity compensation controller:
		Arm position maintained compensating gravity
		Compliant behaviour of the arm
		Differential drive controller:
		Velocity-based controller for the mobile base
		Available RViZ Plugin to navigation to a point in a map
	Upper body motions	**play_motion**
		Pre-recorded motions handling
		Allows execution with planning and self-collision avoidance
		play_motion_builder
		Generation of pre-recorded motions
		Available QT-based GUI
		MoveIt!
		Fully integration that works off-the-shelf
		Motion generation with path planning and self-collision avoidance
		Available RViz Plugins

PAL ROBOTICS

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CONTROL	Whole Body Control Package	**Controller based on a quadratic solver that solves a hierarchical set of tasks**
		Provides on-line inverse kinematics of the robot's upper body (arm, torso, head)
		Default stack of tasks contains:
		Self-collision avoidance
		Joint limit avoidance
		Allows for:
		Cartesian Gaze control
		Cartesian control of end-effector
		Admittance compliant control (if there is F/T sensor)
		Joint space control of upper body
		Compliant behaviour of the arm
	Visual Programming Package	Intuitively programming the robot with a block based drag-and-drop graphical interface based on behaviour trees
		Monitor robot's state and diagnostics in real time, including current status of: battery, network, volume, and emergency button, navigation mode
		Easy access to pre-recorded motions and speeches
		Creation of buttons that trigger robot motions or speech
NAVIGATION	Advanced Navigation Package	Obstacle avoidance using RGB-D head camera
		Navigation to points of interest (PoI) or through a sequence of PoI
		Detection of zones of interest (ZoI) (topological localization)
		Avoidance of virtual obstacles / forbidden regions
		Map Editor:
		Download / Upload maps in the robot
		Add virtual obstacles, forbidden regions, PoI, ZoI
		Graphical joystick to control the robot in the map

TIAGo® PREMIUM SOFTWARE

Free simulation and tutorials at
wiki.ros.org/Robots/TIAGo

HUMAN-ROBOT INTERACTION

Text-to-speech

Add extra languages and voices

Facial Perception Package

Face detection, face maching, face tracking
Recognition of 6 basic emotions
Recognition of Facial features

Automatic Speech Recognition Package

Google Cloud Speech API off-the-shelf integration
Provides ASR for over 125 languages and variants

Animation Interface Package

Creation and edit of new motions with the arm, head, and torso:
- Arm, head, and torso: Joint by joint via sliders
- Arm: moving the robot manually in gravity compensation mode

Building new presentations that combine robot speech, and motions

Monitor the robot's state and diagnostics in real time, including current status of: battery, network, volume, and emergency button, navigation mode

Easy access to pre-recorded motions and speeches

Creation of buttons that trigger robot motions or speech

Advanced Grasping Package

Perform complex grasping tasks combining behaviour trees and MoveIt!

Based on server-client structure implemented with ROS Actions, using action servers:
- Perception server
- Grasp server
- Place server
- Custom servers

Detect objects based on basic shapes and colour

Customisation of parameters:
- Grasp candidate
- Object detection

General configuration (behaviour trees and actions)

Two out-of-the-box demos:
- Stack cubes
- Clear table

PAL ROBOTICS

ONE ROBOT, ENDLESS POSSIBILITIES

Adapt TIAGo to your research needs by customizing it from start with its countless expansion possibilities. PAL Robotics offers a catalog of add-ons to expand TIAGo's capabilities and opens the door to let you easily connect your own devices on it. Adjust your robot to your needs, and turn TIAGo into your best research companion!

Thermal Camera

Expansion panel

NVIDIA® Jetson™ TX2

Omnidirectional Base

Android Tablet

Touchscreen

Interchangable grippers

Robotic 2F 85/140

ARTIFICIAL INTELLIGENCE KIT

NVIDIA® Jetson™ TX2

The perfect kit for Artificial Intelligence applications or Machine Learning developments. Integrate an NVIDIA® Jetson™ TX2 Kit into TIAGo and benefit from one of the fastest and most power-efficient computing devices so nothing stops your algorithms. Explore the potential of the AI and robotics synergy.

Start implementing AI-based applications with TIAGo!

YOUR WAY OF SENSING

Equip TIAGo with the sensors and devices needed to easily perceive the environment as you require. We know each research field demands a specific way of seeing the world.

GRIPPER CAMERA

THERMAL CAMERA

YOUR OWN SENSORS

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TIAGo®
accessories

GRAPHICAL INTERFACE

Broaden TIAGo's applications and interaction skills with a graphical interface!

TOUCHSCREEN

An integrated touchscreen can be a useful means for commanding TIAGo, interacting with it, or checking the robot's state.
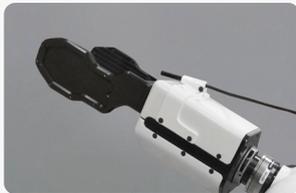
ANDROID TABLET

An Android tablet installed on top of TIAGo's head. Android apps and web-based interfaces open new possibilities to give orders to TIAGo, trigger a task or understand the robot's status.
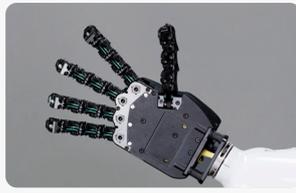
TAILORED GRASPING

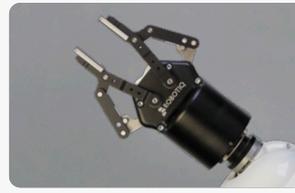Use the End-effector that fits your needs:

Parallel Gripper
· Current limit control
· 2 DoF
· Gripper camera optional

Hey5 Hand*
· Current limit control
· 19 DoF (3 actuated)

Robotiq™ 2F 85/140
· Current limit control
· Gripper encompass objects
· No current consumption to stay in fixed position

Robotiq™ EPick
· Electrical vacuum generator
· Standard suction cups

(*) Developed by PAL Robotics S.L., with contributions from QBrobotics srl. The Hey5 hand is a derivative of the "Pisa/IIT SoftHand" open source project by M. G. Catalano, G. Grioli, E. Farnioli, A. Serio, C. Piazza and A. Bicchi, distributed under Creative Commons Attribution 4.0 International License and available at NaturalMachineMotionInitiative.com

ADD YOUR ADD-ON!

Expansion Panel
Connect microphones, cameras, any sensor or device you want to TIAGo, and widen your robot's abilities right the way you need it.

Mounting Points
TIAGo has mounting points on its head, laptop tray and mobile base to handily fix the equipment on its body.

Laptop Tray
Connect your laptop to its onboard computer through the expansion panel. The tray is also an adequate surface to permanently add new devices.

TIAGo OMNI BASE

2 LiDAR Sensor for an unobstructed 360º FOV secure movement, it can include autonomous navigation, obstacle detection and path planning.

Learn more

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