

Robotino®

Mobile robot platform for research and training

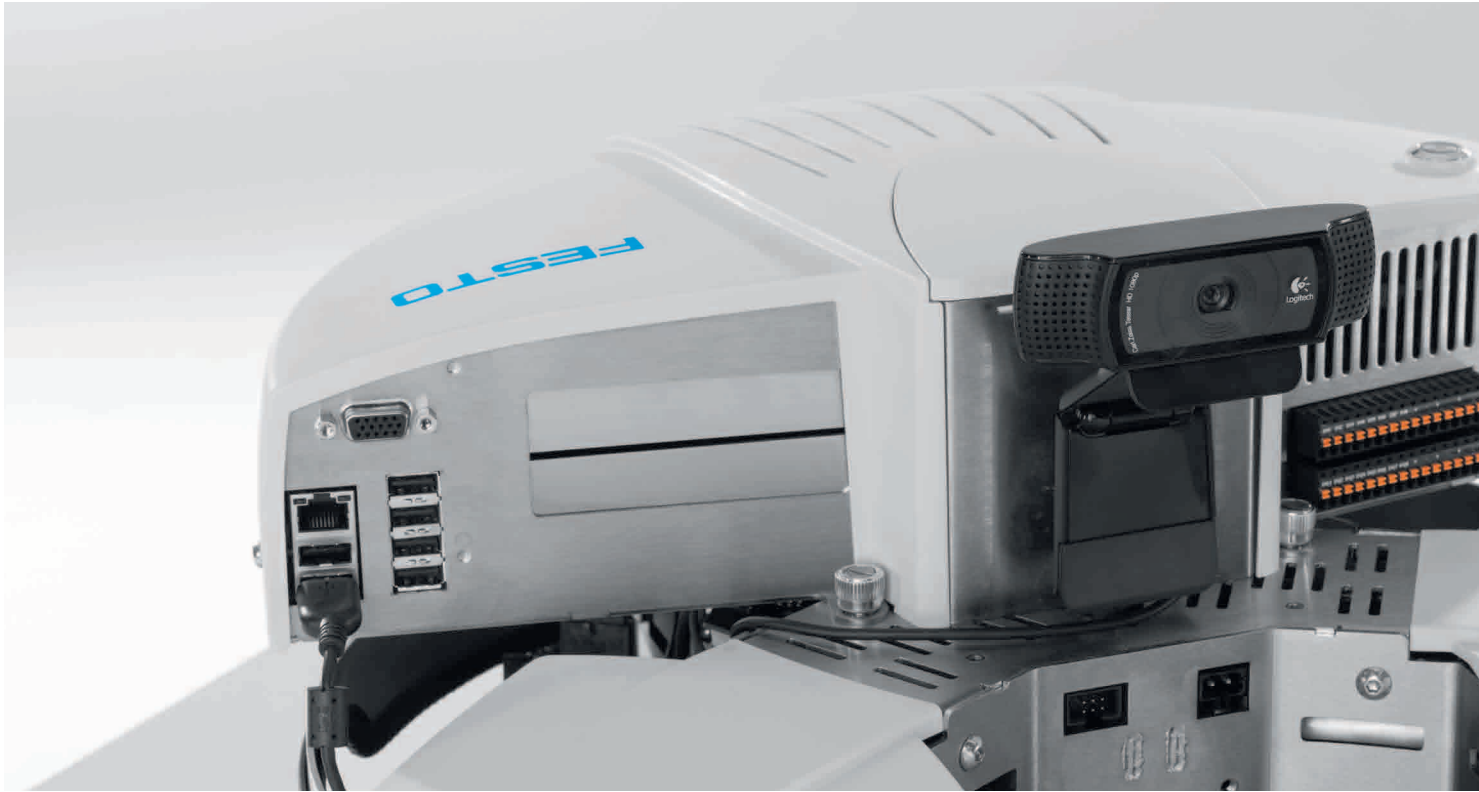
FESTO



Robotino®

New potential at all levels

New



Mobile robot platform for research and training

With its omnidirectional drive, sensors, interfaces and application-specific extensions, Robotino® is equipped for universal use.

The most important programming languages and systems are available for programming individual applications.



Mobile robotics and service robotics

Just as industrial robots, mobile and service robots are also becoming more and more important. In keeping with this technical and economic trend, the new Robotino® forms the basis for research and training in these applications.



Extremely powerful:

The new computer performance

With scalable computer performance for autonomous control, image processing and the evaluation of data from laser scanners.

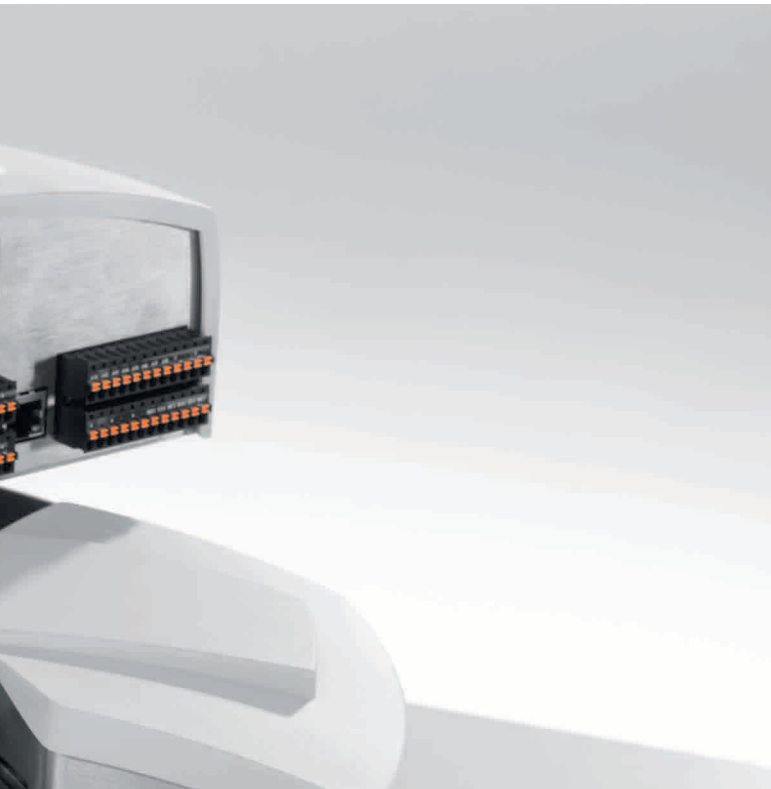
More interfaces than ever before

More convenient, faster, more diverse: new, state-of-the-art functions ensure greatest possible system expandability.



Open source concept

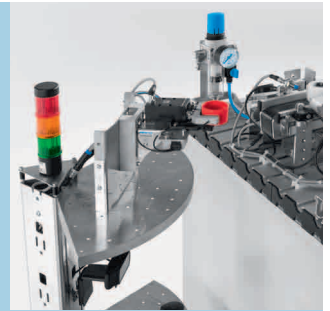
Full access to the entire source code for the implementation of robot applications with common programming languages and systems.



**Fit for research:
With the Robotino® for Industry 4.0**

With its new, flexible operating height, Robotino® has been fully integrated into the world of MPS® systems and research factories as an autonomous transport system.

Once programmed, Robotino® automatically identifies, for example, the correct MPS® station – the first step towards a fully automated production system!



Gefördert durch:



Bundesministerium
für Wirtschaft
und Technologie

aufgrund eines Beschlusses
des Deutschen Bundestages



Sturdy and movable

With three independently driven omniwheels, Robotino® can move in all directions. The stainless steel structures of the frame ensure high stability in every travel situation.



**Payload greater
than unladen weight**

Thanks to its sturdy design, Robotino® can move a payload of up to 30 kg while weighing 20 kg itself.



Flexible and adaptable design

Numerous mounting choices and the optional mounting tower with individually positionable platforms ensure that Robotino® can be used for a wide variety of tasks.



Plug and play

Robotino® supports various grippers, manipulators and sensors through plug and play. Robotino® recognises these components once they are connected, and the control can begin.

Robotino®

For research and education: Premium Edition and Basic Edition

New



Select your version!

Robotino® is available in two standard versions, **Premium Edition** and **Basic Edition**. These two versions differ in computing power, the size of the internal memory and the mechanical extension, the mounting tower.

Omnidirectional drive

The three drive modules of the Robotino® are integrated in a stable, laser-welded stainless steel frame. With its omnidirectional drive, Robotino® moves quick as a flash forwards, backwards and sideways and also turns on the spot. Three sturdy industrial DC motors with optical rotary encoders permit speeds of up to 10 km/h.

Everything in view

The frame contains nine infrared distance sensors. An analogue inductive sensor and two optical sensors are additionally available, enabling the Robotino® to recognize and follow predefined paths. Robotino® is supplied with a colour camera with full HD 1080p resolution.

Uninterrupted use

Power is supplied via two 12 V non-spillable lead-gel rechargeable batteries which permit a running time of up to four hours. The system is automatically switched off in time if the state of charge is too low. A power supply unit and a jack are included in the scope of delivery, which means that Robotino® can also be used for experiments or further development of control programs while it's charging.

Premium Edition	8029256
Basic Edition	8029346

Included in scope of delivery:

Mobile robot system

- Diameter: 450 mm, height incl. controller housing: 290 mm
- Total weight: approx. 20 kg (without mounting tower), payload: max. 30 kg
- Circular stainless steel frame with omnidirectional drive
- Rubber protection strip with built-in collision-protection sensor
- 9x infrared distance sensors, 1x inductive sensor, 2x optical sensors
- Colour camera with full HD 1080p resolution and USB interface
- **Premium Edition:** mounting tower with three mounting platforms

Control and interfaces

- Embedded PC to COM Express specification
- **Premium Edition:** Intel i5, 2.4 GHz, dual core, 8 GB RAM, 64 GB SSD
- **Basic Edition:** Intel Atom, 1.8 GHz, dual core, 4 GB RAM, 32 GB SSD
- WLAN to specification 802.11g/802.11b as client or access point
- Motor control with 32-bit microcontroller and free motor connection
- 2x Ethernet, 6x USB 2.0 (HighSpeed), 2x PCI Express slots, 1x VGA
- 1x I/O interface for integrating additional electrical components

Software

- Graphical programming environment for external PC that runs on Windows XP, Vista, Windows 7/8
- API for programming with C/C++, JAVA, .Net, LabVIEW, MATLAB/Simulink, ROS and Microsoft Robotics Developer Studio

Control

At the heart of Robotino® is an embedded PC to the COM Express specification. This is how the scalability of the computing power is achieved. In the two standard versions of Robotino®, an Intel Core i5 processor with 2.4 GHz or an Intel Atom processor with 1.8 GHz is used. The embedded PC can be exchanged at any time. The operating system and all user data are stored on a solid state disk (SSD) with 64 GB or 32 GB.

A 32-bit microcontroller that directly generates the PWM signals for actuating up to four electric DC motors is responsible for the motor control. An FPGA is used to read in the encoder values of the motors. This enables, for example, the odometer data and any additional sensor-specific correction data to be calculated directly in the microcontroller.

Expandability

Additional components can be connected to the robot controller via standard interfaces such as USB and Ethernet. For subsequent expansion, the controller also provides analogue and digital inputs/outputs and relay outputs for additional actuator technology. In order to support interfaces such as EIA-485 and IEEE 1394 that are not available in the standard versions, there are two PCI Express slots for interface cards. Additional electric axes and grippers, for example, can be connected to an additional motor output and encoder input. The Premium Edition already contains the optional mounting tower for Robotino®. The mounting column of the tower offers various options for fastening mounting platforms for manipulators or sensors at different heights.



Robotino® Basic Edition

The variant for use in technical basic and further training with less computing power, less memory and without a mounting tower.



Also order:

Robotino® Workbook

Campus licence (→ Internet):

de	8029494
en	8029495
es	8029496
fr	8029497

Recommended training media

- Robotino® SIM Professional
- Robotino® SIM
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Graphical programming

Robotino® View is the interactive, graphical programming and learning environment for Robotino®. It communicates directly with the robot system via wireless LAN. The programming system combines state-of-the-art operating concepts, expandability by the user and intuitive operation. After the program has been developed, it can be loaded into the controller of Robotino® in order to enable completely autonomous operation.

First steps with simulation

As an add-on, you can use an attractive 3D simulation package (Robotino® SIM), which simulates the Robotino®'s travel behaviour and sensors in an appropriate working environment. This allows you to test your programs in the simulation first.

Open programming environment

The programming interface (API) of Robotino® allows various programming languages and systems to be used to develop a control program. The API supports the following languages and systems:

- C/C++, JAVA, .Net
- LabVIEW and MATLAB/Simulink
- Robot Operating System (ROS)
- Microsoft Robotics Developer Studio

Hardware-in-the-loop scenario

If you create your own motor controller, e.g. in MATLAB, the motors of Robotino® can be controlled with this software controller via the Ethernet interface.

Microcontroller programming

The 32-bit microcontroller is externally accessible and can be used directly for programming custom applications.

WLAN access point



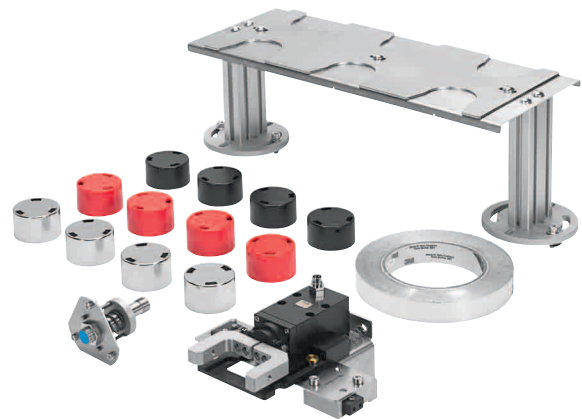
This external access point supports the W-LAN standard IEEE 802.11g with a transmission rate of up to 54 Mbps.

The external access point enables you to connect multiple Robotinos® to an Ethernet PC network without any problems. To do this, the Robotinos® only need to be switched to client mode. The Allnet access point is preprogrammed for you, and will automatically start communication with the Robotinos®. To secure the wireless network externally, WEP/WPA encryption and MAC address filters are implemented.

Scope of delivery

- Access point
- Programmed with “Robotino® APX.1”
- USB power cable and Ethernet cable

Logistics Kit



The Logistics Kit consists of an electric gripper, flat storage area with 2 rows, an inductive sensor and a set of workpieces.

The **electric gripper** is completely integrated in the Robotino® platform, so that while it is moving, monitoring is not necessary for potential collisions with the gripper. The gripper detects workpieces between the gripper jaws by means of an integrated through-beam sensor. To pick up a workpiece from a bearing surface, a slide is integrated, which signals the optimal position for the gripping process to the Robotino®. The gripper end positions are checked via the motor current evaluation.

The gripper function is available as a functional module in Robotino® View (starting from Version 1.7).

Scope of delivery

- **Electric gripper**
Gripper stroke: 4 mm
Maximum workpiece diameter: 40 mm
Maximum workpiece weight: 300 g
Gripping force: 140 N
Closing/opening time: 2 s
Operating voltage: 24 V DC
Maximum current: 140 mA
- **Analogue inductive sensor** for mounting in the middle of the robot frame
- **Flat storage area** with 2 rows and 3 storage places per row for cylinder-shaped workpieces with a maximum diameter of 40 mm.
- **Workpiece set**
- **Aluminium adhesive tape** for marking the access routes to the storage area, which the Robotino® can align itself on for gripping the workpieces.

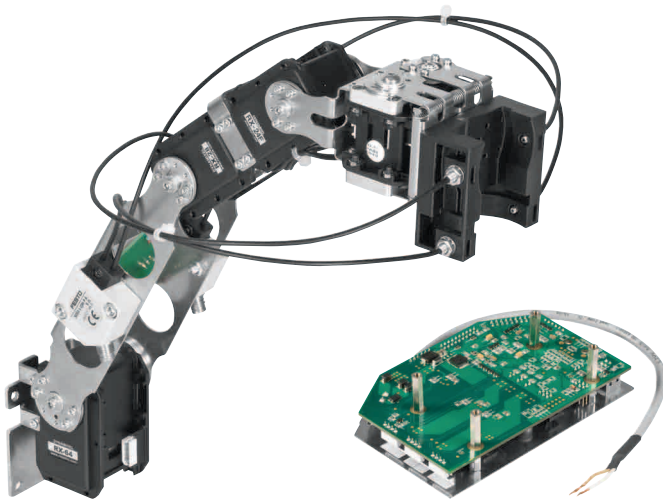
Robotino from 2014	8029450
Robotino until 2013	564179

The most important components at a glance:

Electric gripper, Robotino from 2014	8029451
Electric gripper, Robotino until 2013	564176
Inductive sensor, analogue, Robotino from 2014	8029483
Inductive sensor, analogue, Robotino until 2013	564177
Flat storage	564178
Workpiece set “Cylinder bodies”	167021
Aluminium tape	564213

Order no. **567228**

Electric gripper arm



The electric gripper arm for Robotino® is a triple-axis gripper arm with servo motors that is installed in the loading bay of the Robotino®. The control board supplied is connected to the power supply (24 V) of the I/O interface and the arm movement controller via the USB interface. The handling weight is limited to 200 g and the gripper stroke is 30 to 60 mm. The unit can grip workpieces in two places. The gripper jaws are fitted with opto-electrical sensors to detect when a workpiece is present.

The gripper jaws supplied allow handling of MPS® workpieces. Robotino® View supports manipulator programming with a list of positions and function blocks for reading and writing axial values. In addition, Robotino® SIM Professional contains a simulation model of the electric gripper arm for Robotino®. The manipulator can also be controlled via the OpenRobotina API.

- Overview of key technical details:
- Load bearing capacity up to 200 g
 - Gripper stroke 30 – 60 mm
 - Two gripping positions
 - Opto-electrical sensors for detecting presence at the gripping positions
 - Controlled servo motors
 - 24 V DC power supply
 - USB connection

Forklift



With the easy to use forklift, the Robotino® operates, for example, as a driverless transport system in a production environment.

Assembly is done in the loading bay of the Robotino® with the assembly material included in the scope of the delivery. The electrical interface of the forklift is possible using the existing additional motor control. Here, the voltage supply and the increment generator are directly connected to the motor plate.

Programme the function of the forklift in the Robotino® view or via the OpenRobotino® programming interface. In Robotino® view you can set the axial speed from -100% to 100% using the “Power output” module component and read the axial position and speed of the linear axis using the “Speed sensor input” module component.

Basic principles and details of the automated logistics can be determined with this extension to the range of applications.

Technical data

- Load bearing capacity up to 4 kg
- Maximum stroke 160 mm
- 2 proximity sensors for end-position monitoring
- 1 diffuse sensor for pallet control
- 2 self-centring pallets (included in scope of delivery)
- Connection via motor controls and encoder input
- Compatible with control board EA09

Robotino from 2014	8029452
Robotino until 2013	574147

Robotino from 2014	8029453
Robotino until 2013	576300

Laser scanner



The laser scanner for Robotino® allows the creation of maps, localisation and navigation, as well as obstacle recognition, thanks to the digital detection of objects on one plane. In order to prevent collisions, the 2D laser scanner Hokuyo URG-04LX-UG01 can be mounted above the controller, for an all-round view, or in the loading bay of the Robotino®. The scanner is connected to the control unit and supplied with power via a USB connection.

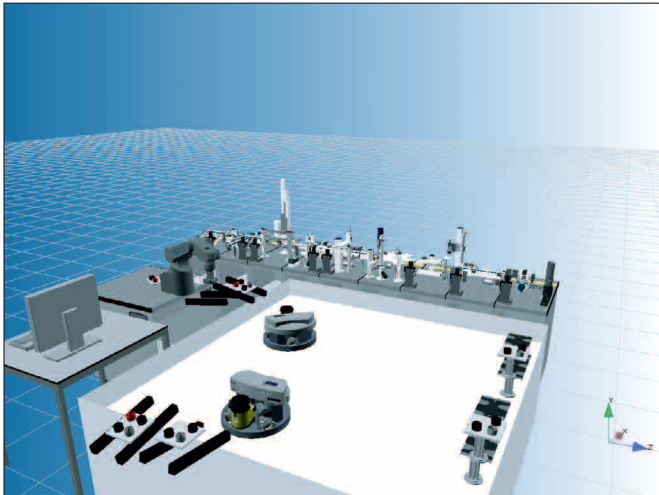
The laser scanner is fully integrated into the Robotino® software architecture. The laser scanner's measured values can be accessed by both Robotino® View and self-developed control programs.

Overview of key technical details:

- Measuring range 20 – 5600 mm
- Angle range 240°
- Resolution 1 mm
- Precision ± 30 mm or $\pm 3\%$ at 1000 mm or greater distance from an object
- Scanning frequency 10 Hz
- Power consumption 2.4 W
- Weight 160 g
- USB connection

Robotino® SIM Professional

Robotino® SIM



Robotino® SIM Professional is an ideal virtual learning environment for working with Robotino®. Identifying differences based on actual behaviour is the key to grasping, analysing and understanding new physical and technical phenomena. The software enables you to create any virtual 3D working environments for Robotino® and then to simulate the program created. The software is available in four languages (de/en/es/fr) and the language selection can be changed online.

The Robotino® simulation model comprises the geometric model with

- three omnidirectional drives
- two inductive analogue sensors
- two digital optical sensors
- nine distances sensors
- a camera
- sensor in the chassis protection strip

The Robotino® library includes additional components such as grippers, slides, laser scanners and workpieces. You are notified of new components in the library via the Internet.

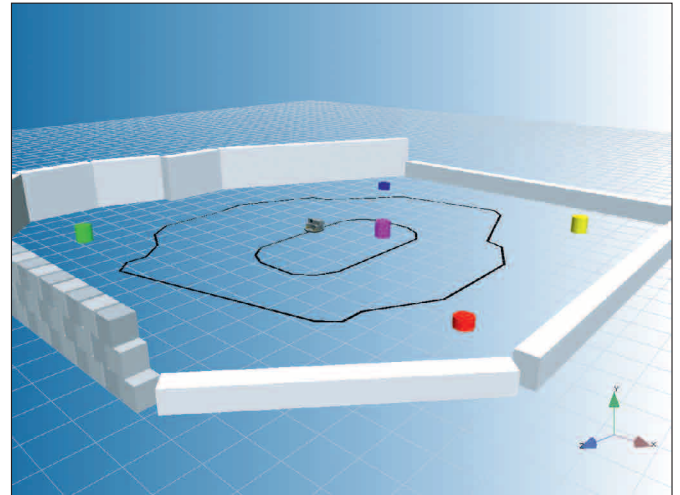
The editor and the complete model library in LabCreator provide you with an outstanding working environment for quickly and easily creating attractive virtual scenarios for Robotino®.

Robotino® can be programmed using Robotino® View or in one of the high-level languages C, C++, C# or Java. To do this, you require the corresponding API interface.

To use the software, you require a Windows 2000, XP, VISTA or Windows 7 operating system. For 3D visualisation, a graphics card with at least 128 MB RAM and OpenGL support is required.

Scope of delivery

- CD with software in de/en/es/fr
- Manual in de/en/es/fr
- 2 dongle with individual licenses
- Network dongle with 25 licenses



Robotino® SIM is a Windows software program for the 3D simulation of Robotino® in an exciting, predefined virtual experimentation environment.

The Robotino® simulation model cannot be extended, and includes the geometric model with the three omnidirectional drive wheels, a camera, nine distance sensors and the digital sensor in the chassis protection strip.

You can program Robotino® free of charge using Robotino® View or using one of the high-level languages such as C++ or Java.

The latest version of Robotino® SIM is now available to download free of charge.

Implementing your own applications with Robotino®



With Robotino®, you can implement your own applications in the fields of mobile robotics and service robotics. The mounting tower allows you to attach standard components or extensions developed by you to Robotino® at any height and to connect them to the control system via the provided interfaces. This means you can convert Robotino® quickly and easily from a forklift truck to a service robot, for example.



1



2



3



4



5



6

A flexible and adaptable design

Remove covers (1)

Fasten mounting column (2)

Fix mounting platform at any level (3)

Connect, align and mount laser scanner and camera (4)

Attach platform with electric gripper and connect gripper (5)

Connect and fasten signal column (6)

Robotino® project ideas

The modular structure, attachment devices and open software interfaces make Robotino® the ideal platform for project work.

With Robotino®, we provide the platform – now nothing stands in the way of developing exciting extensions. This is how fascinating projects are created. A few of them are described here. More detailed information can be found at www.robotino.de

The advantage for you:

- Reliable design – stable frame: no investment in mechanical maintenance
- Operating system based on Linux or Windows – for software reliability
- Powerful drive unit and high-quality omnidrive – concentrating on an intelligent solution for the project task

Technical defects, non-reproducible effects and undesired project delays are therefore a thing of the past.

Would you also like to implement projects with Robotino®?
E-mail: did@de.festo.com.

ProLog factory

The ProLog Factory provides an outstanding new training platform for logistics. The material flow is implemented using Robotino® mobile robot systems, which also have an integrated lifting arm to pick up and deposit pallets at different stations for a specific job.



World champion!

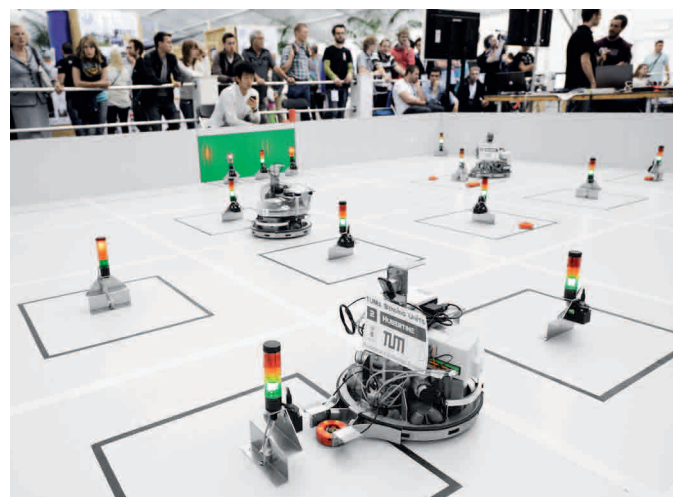
Robotino® is the official competition equipment for the WorldSkills international competition. In the national preliminary rounds as well as the international championships, the participants of the competition use Robotino® mobile robotics as an autonomous transport system or as a service robot, for example.



Fit for research:

RoboCup Logistics League

Researchers from all over the world compete against each other in the RoboCup Logistics League, in which Robotino® takes on the task of an autonomously operating driverless transport system. As from 2014, the new Robotino® is also permitted in the RoboCup.



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