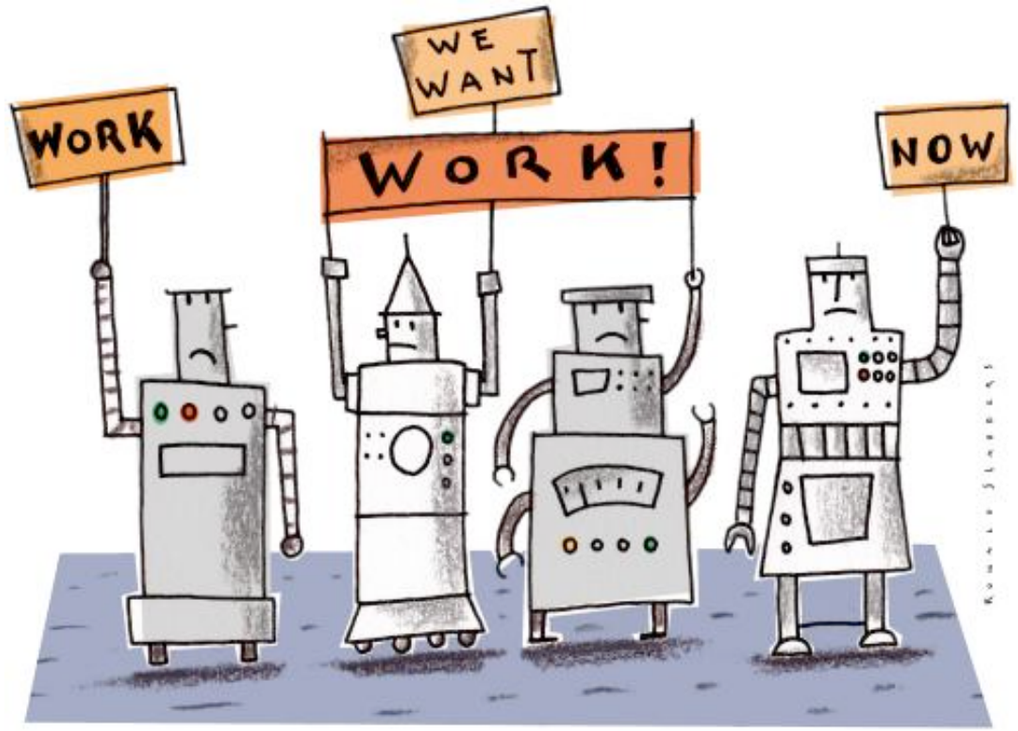
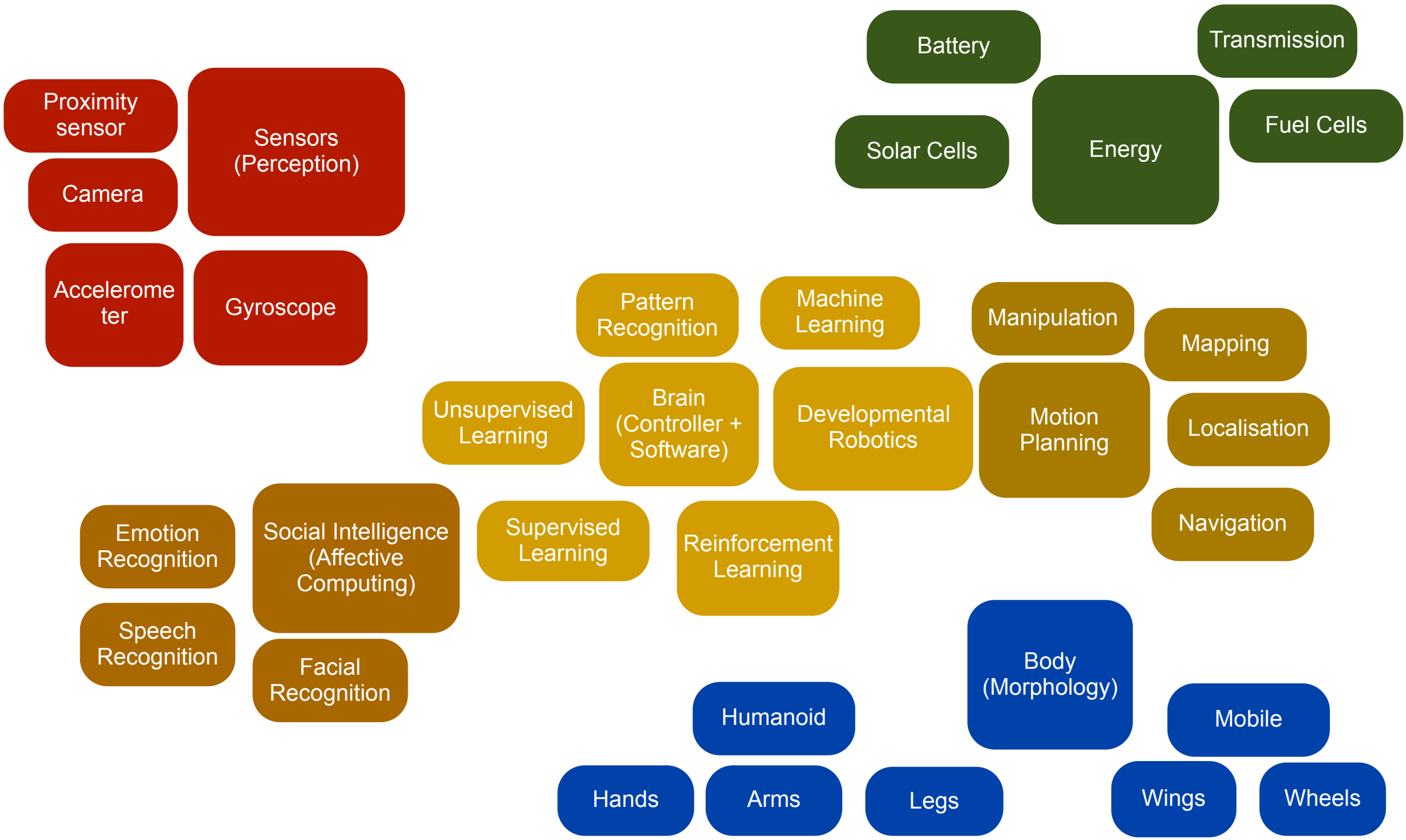
Innovation Rex



Industrial Robotics: An Introduction

Onat Ekinci, PhD

Robotics Ecosystem



Overview

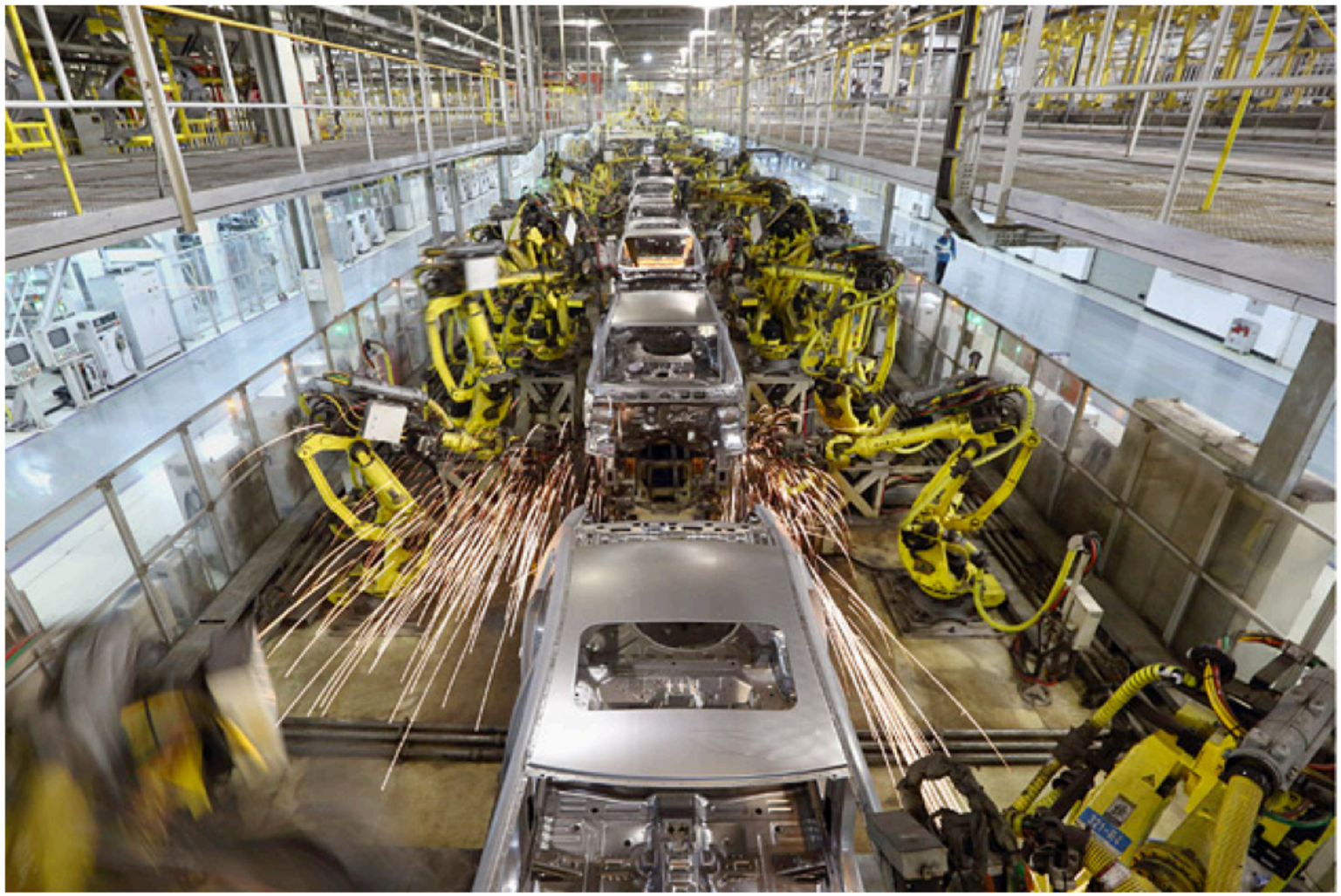
- Some Fundamentals on Robotics
- Established Industrial Robots (For Big Manufacturers)
- Emerging Industrial Robots (For SMEs)

News

China Expected to Be the Top Market for Industrial Robots by 2016

By Christina Larson | November 15, 2013

SEND TO kindle



Photograph by Tomohiro Ohsumi/Bloomberg

http://www.businessweek.com/articles/2013-11-15/china-expected-to-be-top-market-for-industrial-robots-by-2016

News

Google Puts Money on Robots, Using the Man Behind Android

Jim Wilson/The New York Times

Andy Rubin is the engineer heading Google's robotics effort. He is the man who built the Android software for smartphones.

By JOHN MARKOFF
Published: December 4, 2013 | 166 Comments

PALO ALTO, Calif. — In an out-of-the-way Google office, two life-size humanoid robots hang suspended in a corner.

FACEBOOK

TWITTER

http://www.nytimes.com/2013/12/04/technology/google-puts-money-on-robots-using-the-man-behind-android.html?_r=0

http://www.nytimes.com/interactive/2013/12/04/technology/google-new-generation-robots-videos.html?src=recg

Some Fundamentals

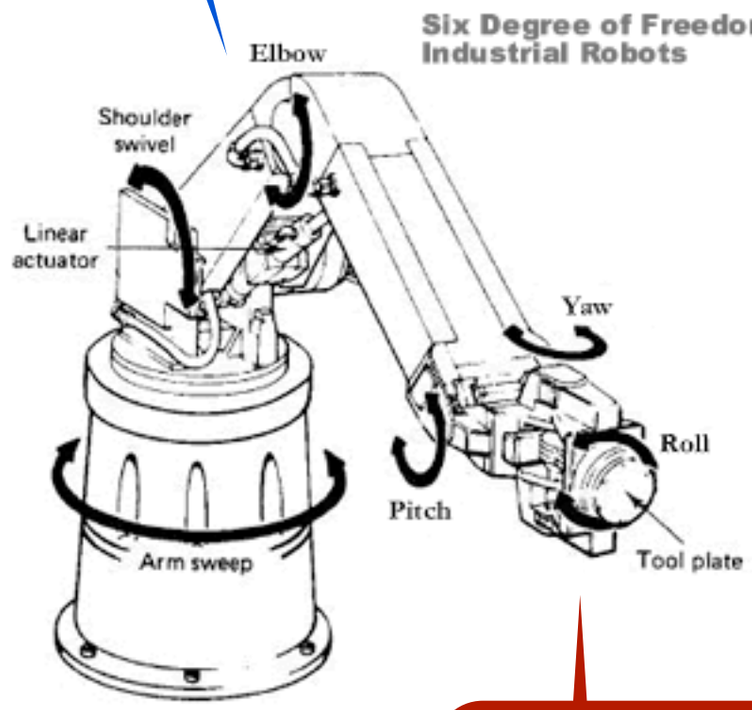
Autonomy and Intelligence

Autonomy

- To sense the environment and act on it *purposefully*.

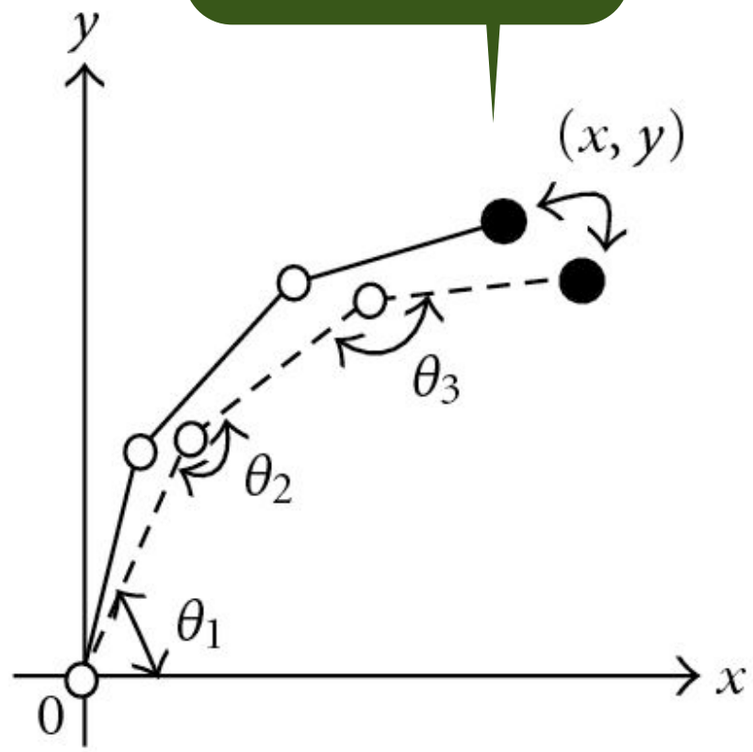
Industrial Robots

Joint Motors



End effector

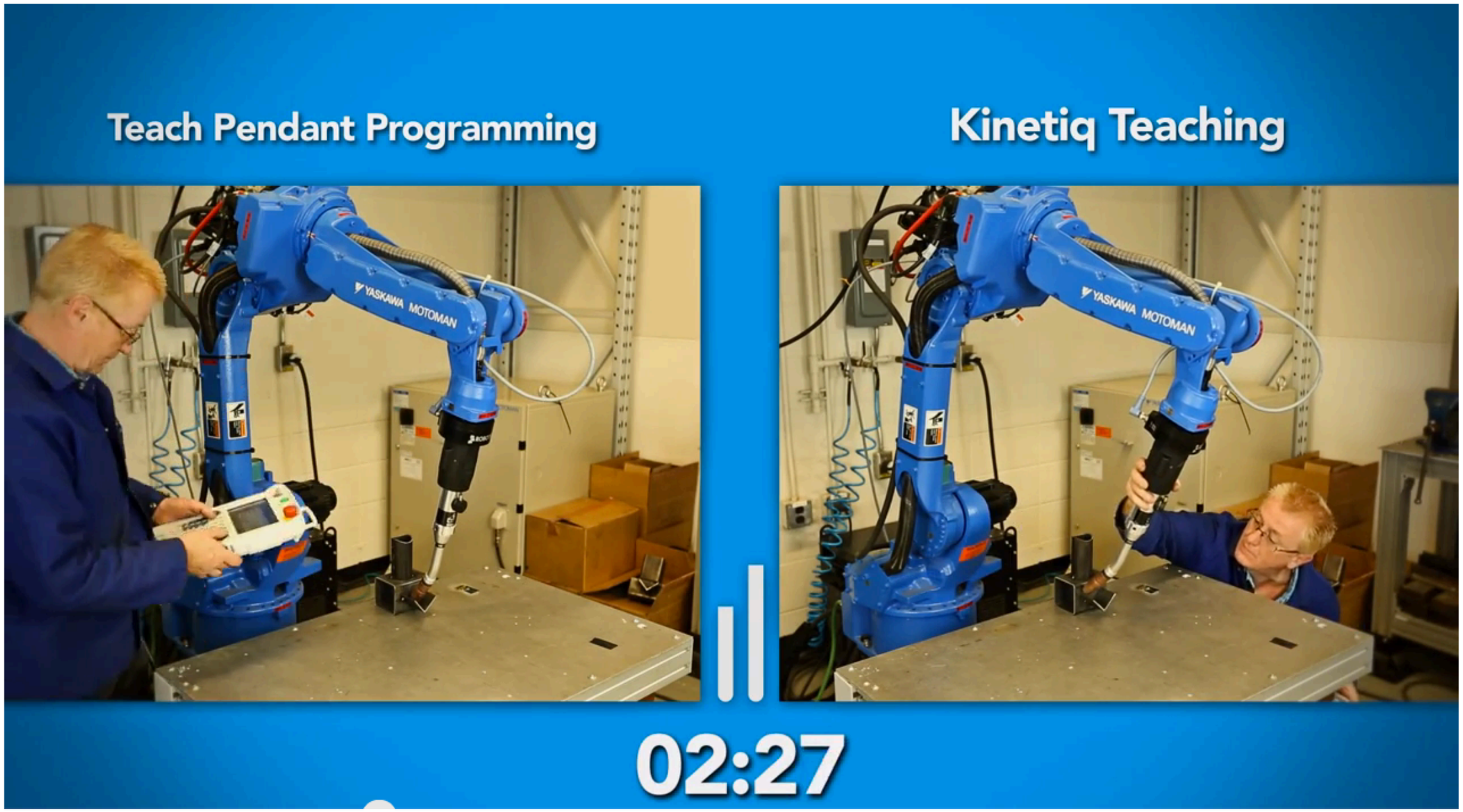
Inverse Kinematics: Go from the end effector position to joint motor angles



Integrated Automated Manufacturing Systems

Choreographed Systems:
No robot is an island.

Robot Programming



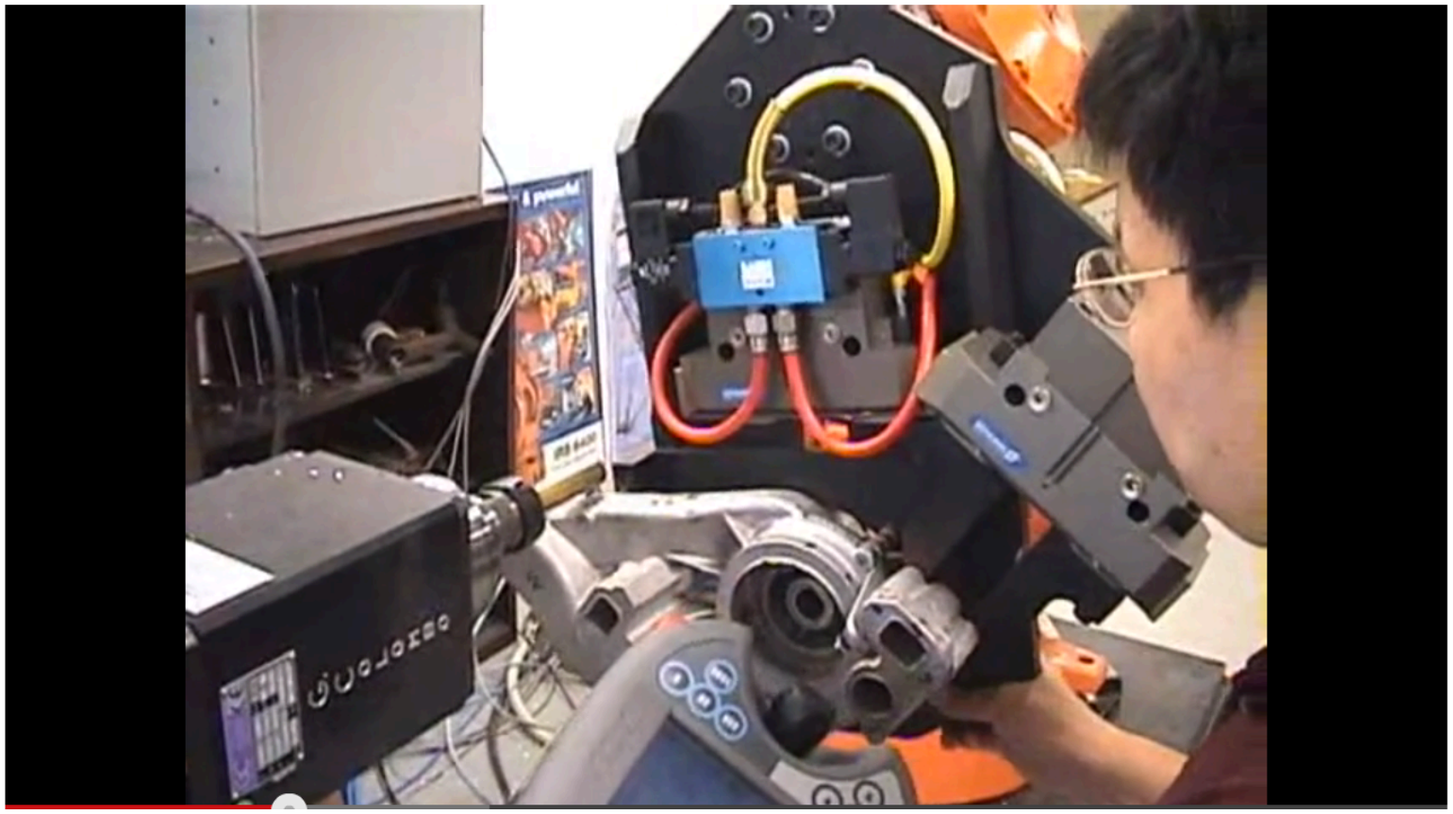
http://www.youtube.com/watch?v=jzR5NZrZSu0

Robot Programming (ABB - 2007)

The ABB Corporate Research Centre has developed a programming method that enables intuitive robot programming. The user grasps the robot and leads it, step-by-step, through the process. At the process-relevant positions, he gives appropriate commands as to what the robot should do.

This intuitive way of robot programming by grasping and guiding, is made possible by the Force Control for Machining Robotware application made available by ABB in June 2007. This software package evaluates data from a force sensor attached to the robot flange and lets the robot move in the pointed direction. With this, the robot can be guided around, like the arm of a person.

Furthermore, the software package offers the possibility of the robot learning contours by itself. The robot fumbles, with the aid of a force sensor, along a roughly defined reference contour and generates a smooth robot trajectory automatically.



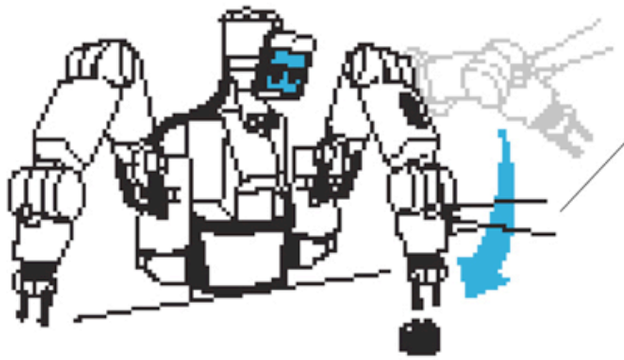
http://www.youtube.com/watch?v=acJ3WDnoDCM

Baxter

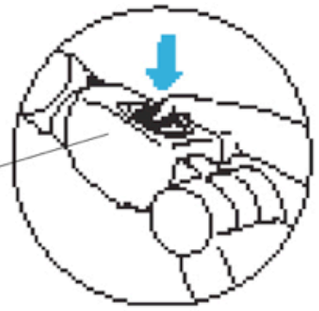
HOW TO TRAIN A ROBOT, IN SEVEN EASY STEPS

Baxter can be trained by anyone, simply by guiding one or both of its arms and following menu prompts on the monitor that serves as Baxter's "head." Screen selections are made by using a sort of mouse built into Baxter's arm. Here's how to train Baxter to pick up widgets and stuff them into boxes:

1. Select training mode.

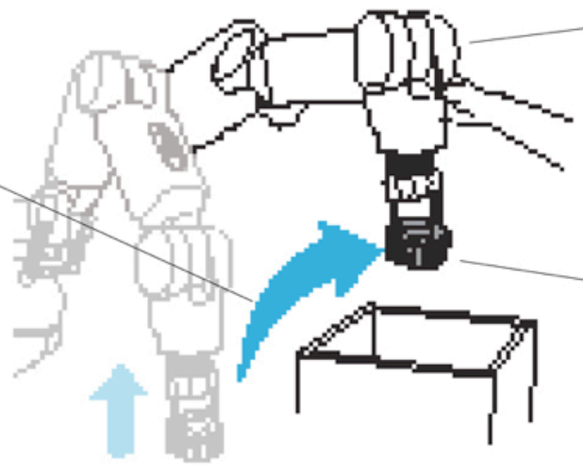


2. Grab one of Baxter's arms and swing its "hand" over the widget, and click to indicate that this is the object to be grabbed.



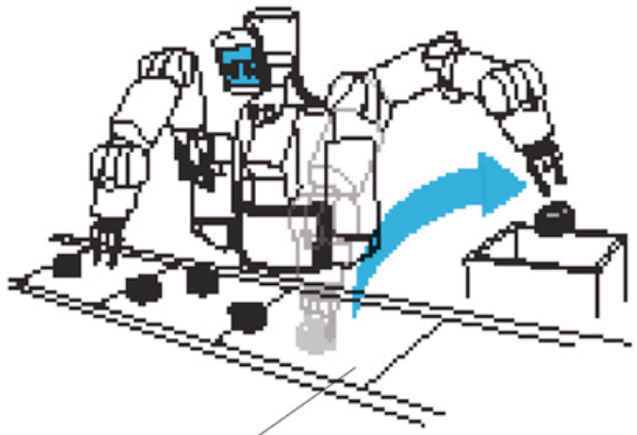
3. A camera in Baxter's hand will center on the widget and display the image on the screen; confirm with a click that this is the right sort of object.

4. Baxter will grab the object. Swing the arm over the four corners of the box, and click to indicate this is the destination for the widget.



5. Click to confirm that Baxter is to insert the widget into the box.

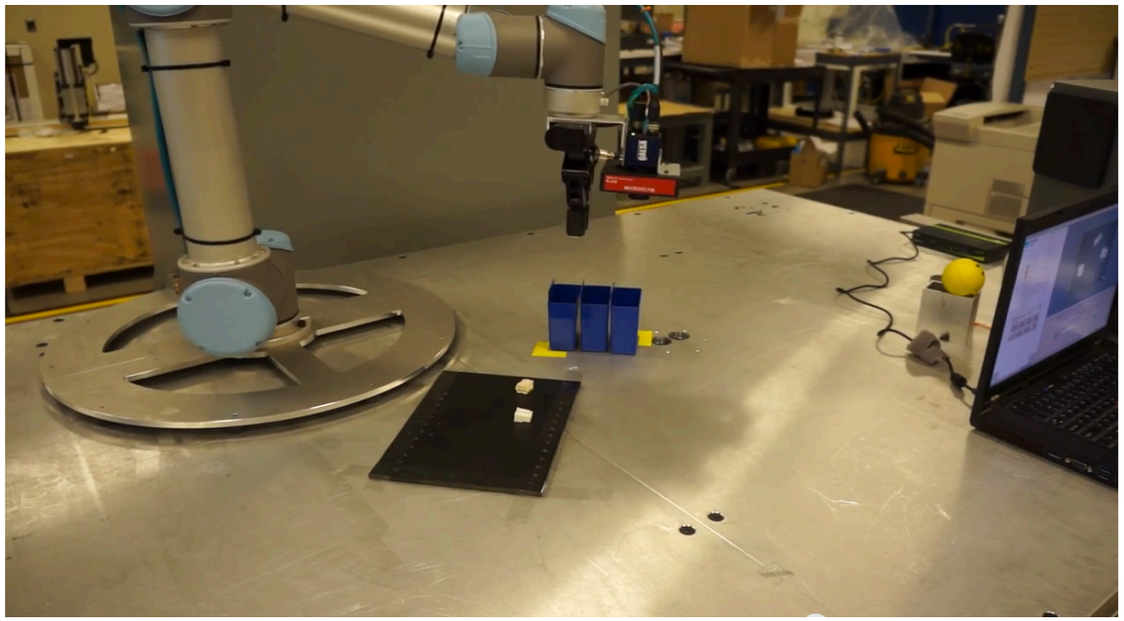
6. Baxter will put the object into the box, using sensors to guide the widget in. Click to confirm that this is the entire task.

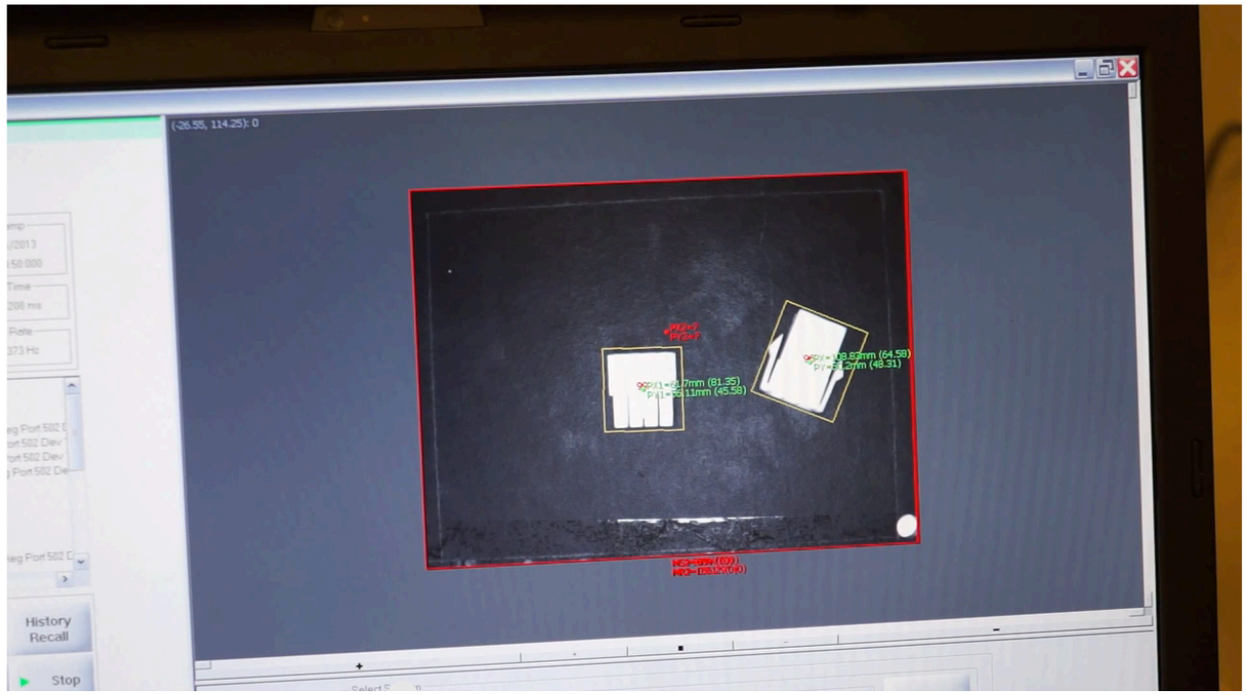


7. Run the conveyor. As long as widgets appear in roughly the same area, Baxter will identify, grab, and box them. Its facial expressions will indicate if it is struggling or working smoothly.

http://www.youtube.com/watch?v=gXOkWuSCkRI

Robot Vision





http://www.youtube.com/watch?v=w7-KGaYGuMA

Innovation Rex

Established Industrial Robots

Robotics Market (Big Players - Established)

The Big Four:

- ABB (53.39B $US - 140k employees)
- Fanuc (29.66B $US - 6k employees)
- Yaskawa Motoman (3B $US -10k employees)
- Kuka (1.7B $US)

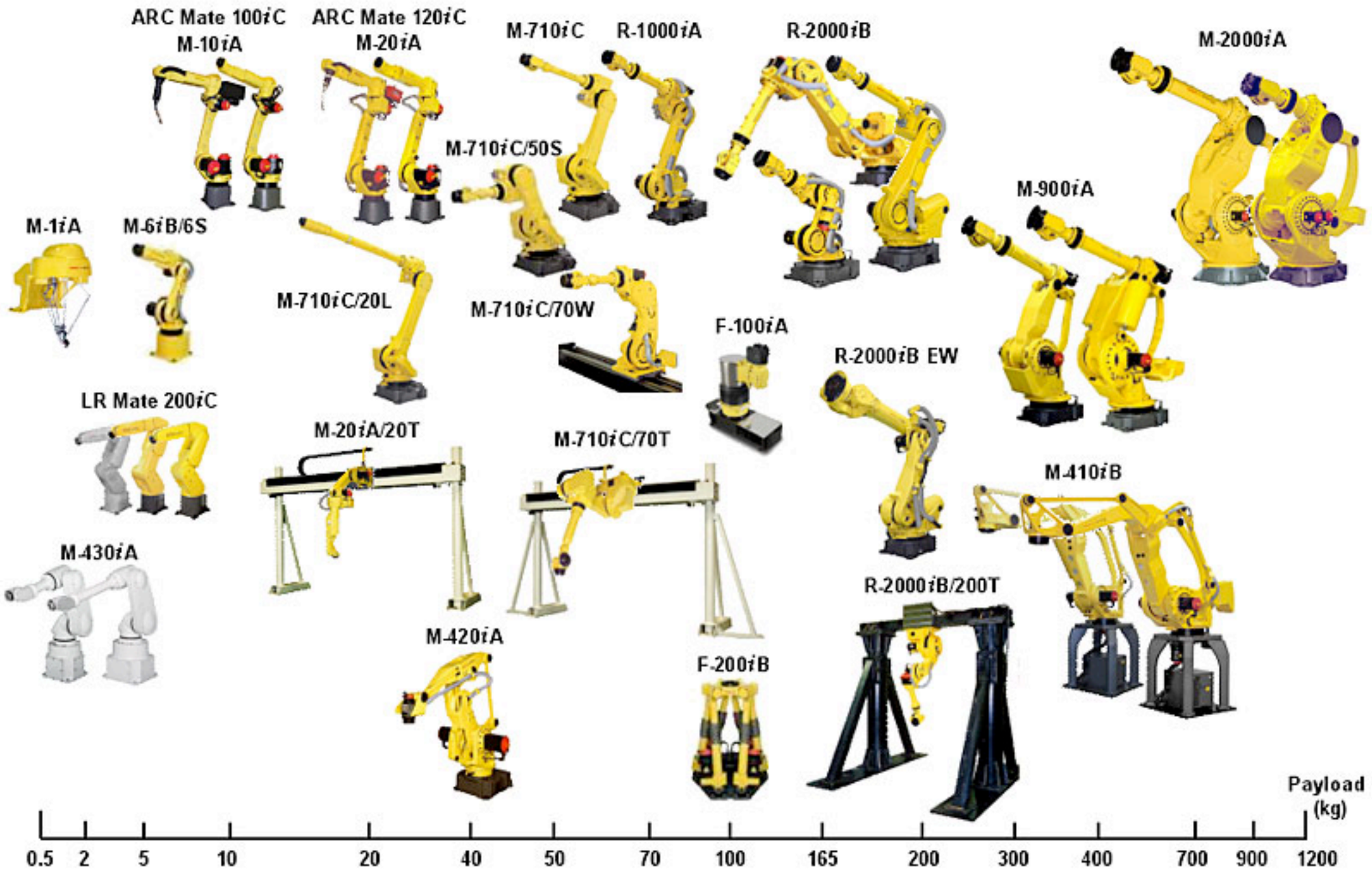
Other Bigs:

- Staubli (Switzerland)
- Toshiba
- Comau (part of Fiat, Italy)
- Reis Robotics (Germany)

Conventional Industrial Robots

- Do the same steps repetitively after programming.
- Designed to be repeatable and precise. Not flexible or adaptable.
- Can operate in structured environments.
- Unsafe for people.

Fanuc Robots



Innovation Rex

Emerging Industrial Robot Technologies (Robots for SMEs)

Robotics Market (Emerging)

- Rethink Robotics
- Universal Robots
- Redwood Robotics (recently bought by Google)
- Unbounded Robotics
- Adept Technology
- Barrett Technology

The Goal of Emerging Robots

- To increase the productivity of SMEs by reducing installation of automation systems.
- To reduce the installation time of a new hybrid robot-human production line,from the weeks or months that current industrial systems now take, down to 1 day.

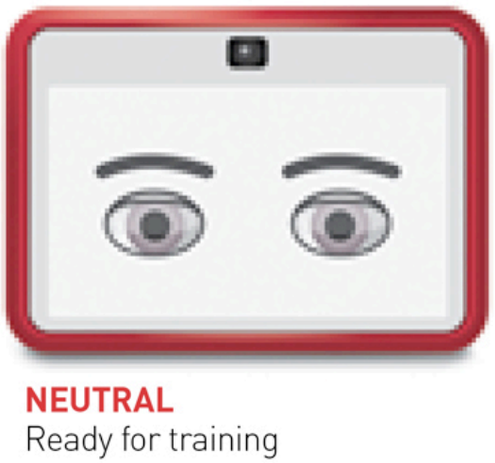
Baxter


Uses the Unified Robot Description Format (URDF) for collaborating across research groups
7 degrees-of-freedom per arm for maximum flexibility and range
360° sonar and front camera for custom sensing applications
Torque, position and velocity sensing on each joint
Software Development Kit for installation on your development workstation
ROS framework for seamless integration across platforms
End-effector specification for designing custom intelligent hands
Fully integrated cameras on head and each wrist for visualizing end-effector interactions
baxter

Baxter

A ROBOT'S EMOTIONS

Brooks didn't set out to build a humanoid robot, but he found that giving Baxter a face was the most intuitive way to communicate information.

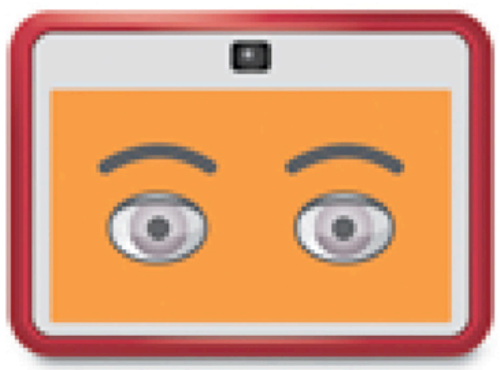


NEUTRAL
Ready for training

ASLEEP
On standby

CONCENTRATING
Learning a task

FOCUSED
Working away without a problem



SURPRISED
A human has approached

CONFUSED
Having trouble finding an object or otherwise completing a task

SAD
Given up trying to complete a task; there's a problem

Baxter

- Series elastic joints. Arms have natural springiness. Not good for precise tasks.

  (Repeatability specification not mentioned in their brochures).

- Payload low compared with most established industrial robots.

Conventional vs. Baxter

Conventional Robots

Precision
Repeatability
Speed

Baxter

Adaptibility
Flexibility
Safety
Price

Baxter is not a competitor for conventional robots but it is for humans.

Willow Garage

Willow Garage

ROBOTS SOFTWARE RESEARCH BLOG SEARCH

PR2

Overview ➡

Design

Specs

Applications

PR2 Community

Funding

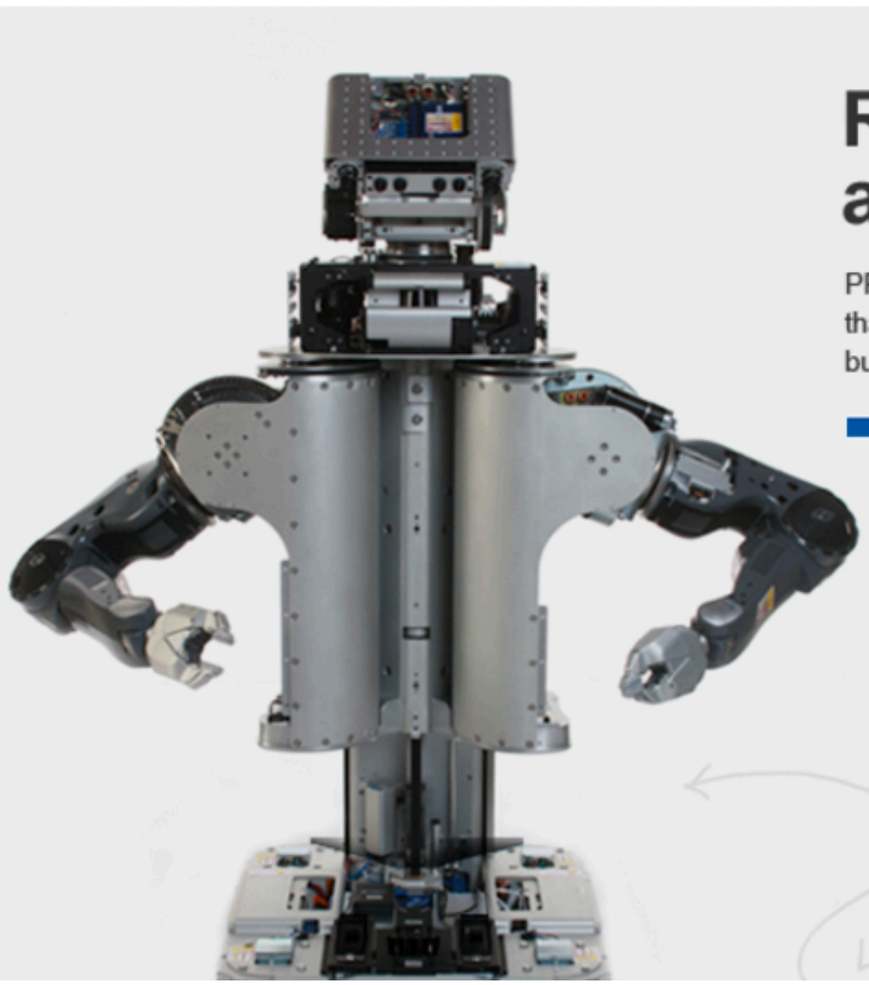
Obtain Quote

PR2 QUESTIONS

650.ILV.RBOT [458.7268]
pr2info@willowgarage.com

Overview

ORDER PR2



Robot for Research and Innovation

PR2 is a robotics research and development platform that lets you innovate right out of the box. No more building hardware and software from scratch.

WATCH OVERVIEW VIDEO

Suitable Technologies

https://www.suitabletech.com/

Unbounded Robotics

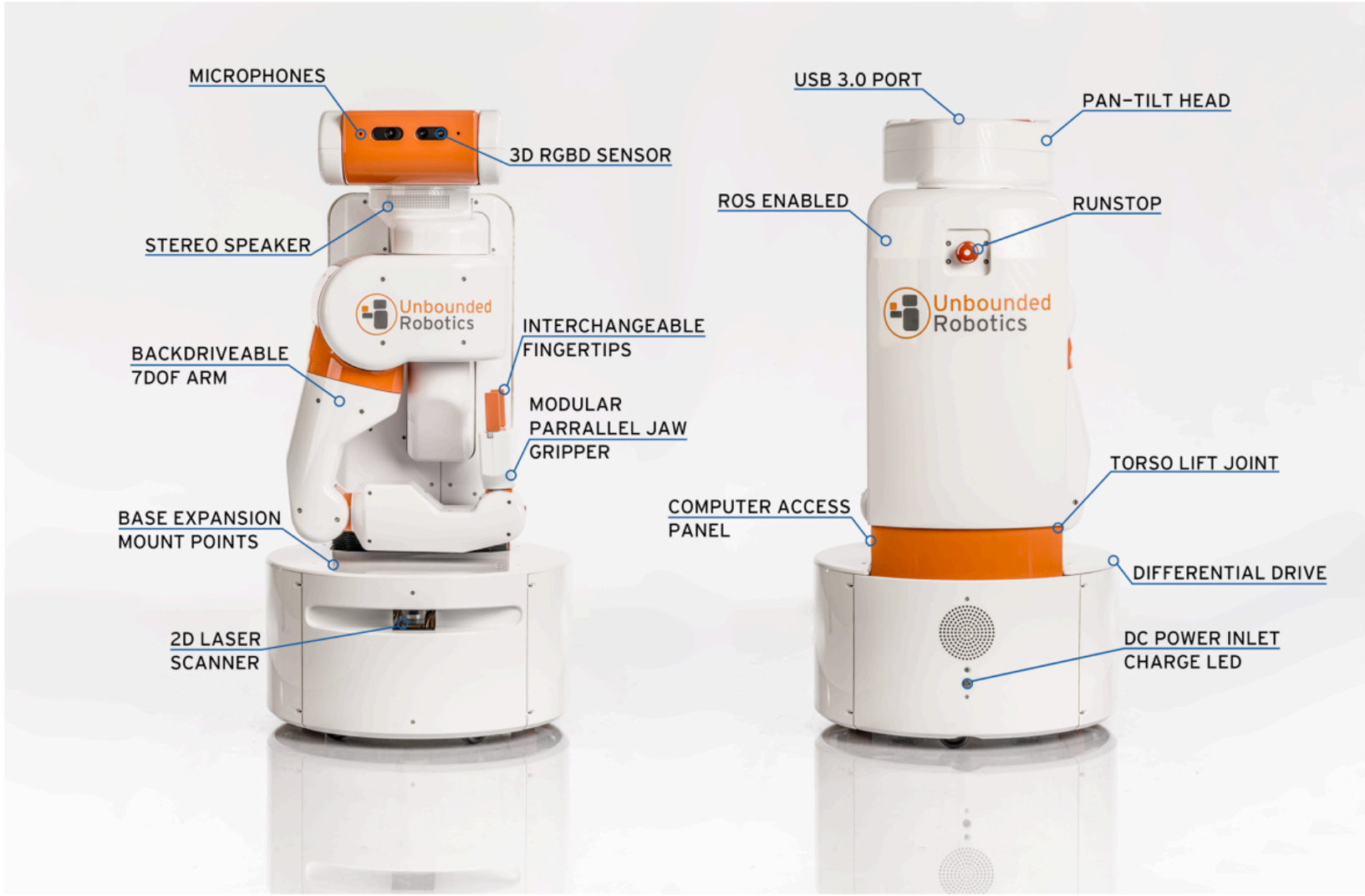
- Willow Garage spinoff (Thus runs ROS)
- UBR-1 : One armed mobile Baxter.
- Platform, open to many applications.

http://unboundedrobotics.com/

Unbounded Robotics

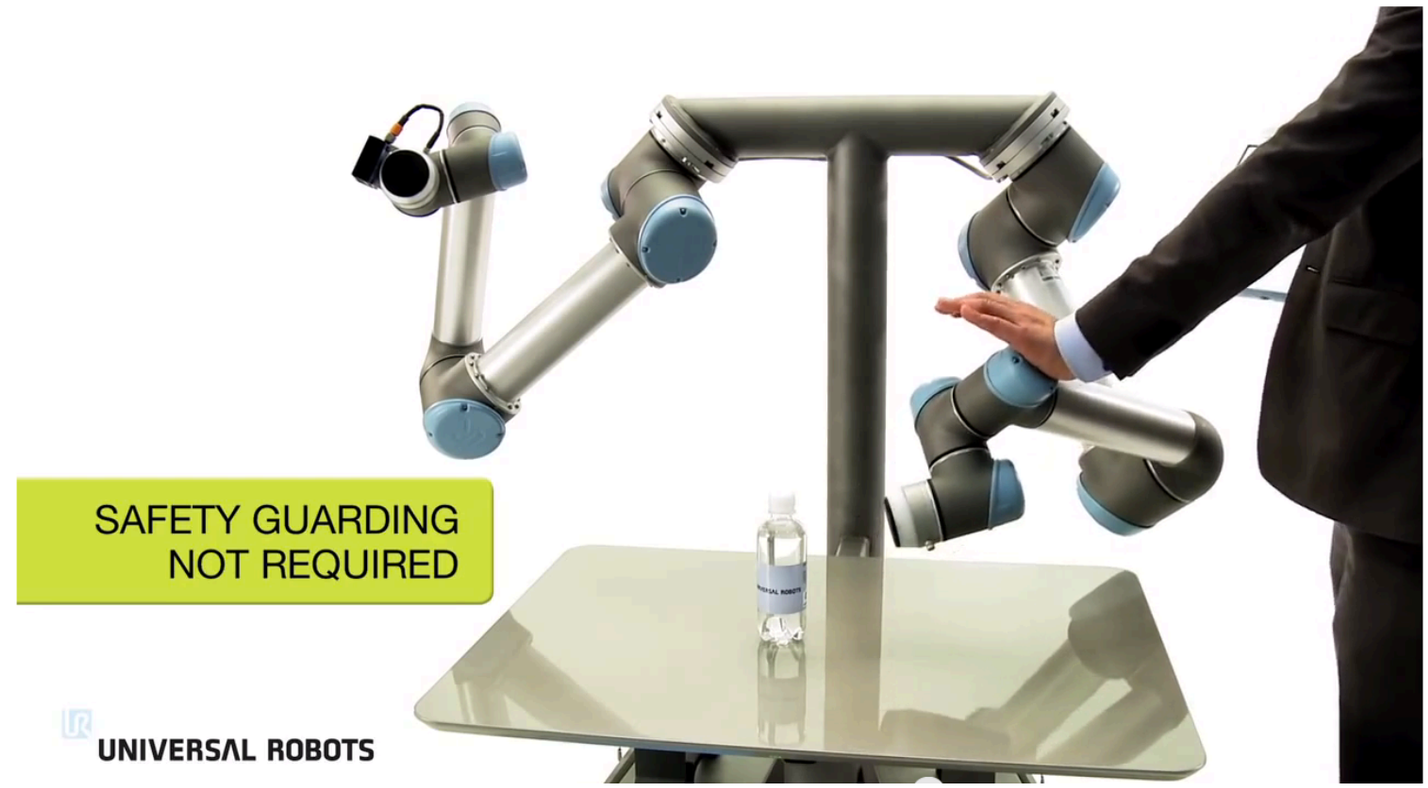
- 2 sensors: Head

  and Torso



Universal Robots

- Danish, founded in 2005.
- UR5 = 35K $US
- Revenue = 15M Euros



http://www.universal-robots.com/

Universal Robots

- UR: Communication with other automation equipment.
- UR: Higher payloads.
- UR: Scripting and teaching programming. RR: Teach only programming.
- UR --> More industrial

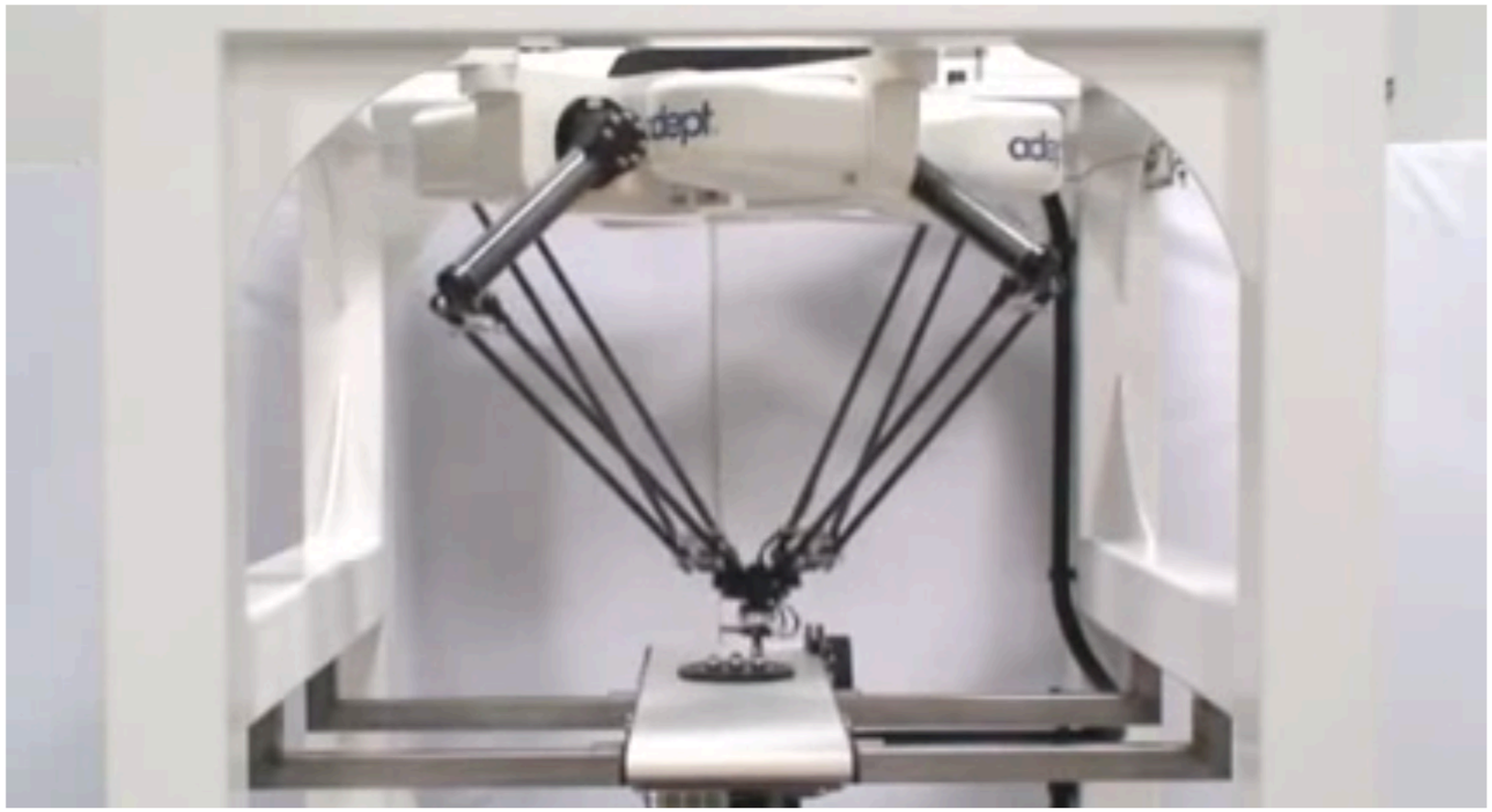
rethink robotics

UNIVERSAL ROBOTS

	Baxter	Universal 5
	Dual-armed	Single arm
Warranteed life	6,300 hours	2 years
Useful life	Unknown	36,000 hours
Maximum load	5 pounds	11 pounds
Vision system	Included	Add-on
Safety	Sonar & cameras	Torsion sensing
Speed	.6 meter/sec	1 meter/sec
Cost	$22,000	$33,000

http://www.youtube.com/watch?v=UQj-1yZFEZI

Adept Technology

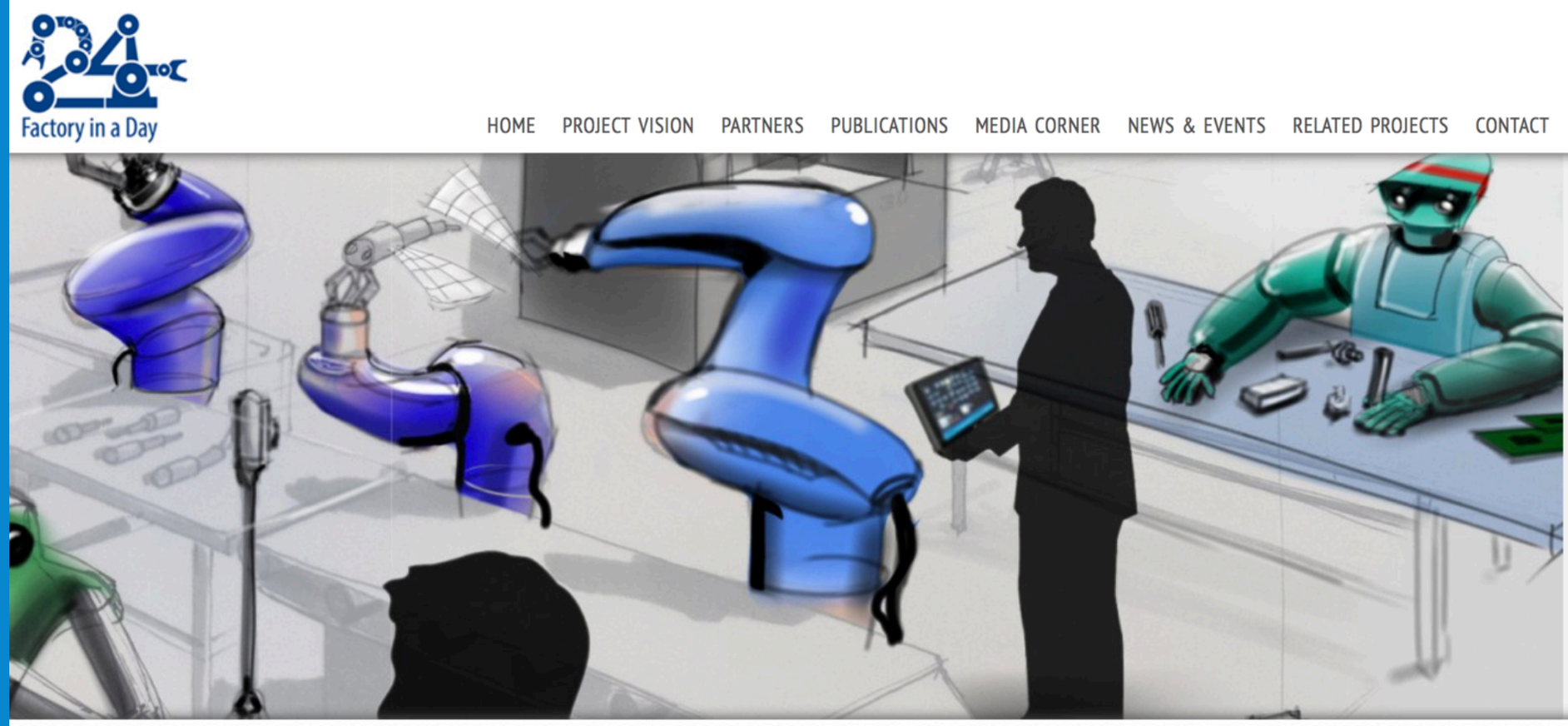


http://www.youtube.com/watch?v=0-Kpv-ZOcKY

http://www.adept.com/products/robots

Offshore Competition is Coming (Or It Was Already There)

The objective of this project is to marginalize the system integration cost by reducing the system integration time to one single day.



http://www.factory-in-a-day.eu/

Offshore Competition is Coming (Or It Was Already There)

We envision a **new generation of flexible robots** and adaptive production machinery, that integrates seamless into manual production processes, assisting the skilled worker in his craftsmanship.

D1: Assembly with dual arm industrial manipulator

D2: Human-robot cooperation in wooden house production

D3: Assembly with sensitive compliant robot arms

D4: Welding robot assistant

http://www.smerobotics.org/demonstrations.html