

Real World Robotics

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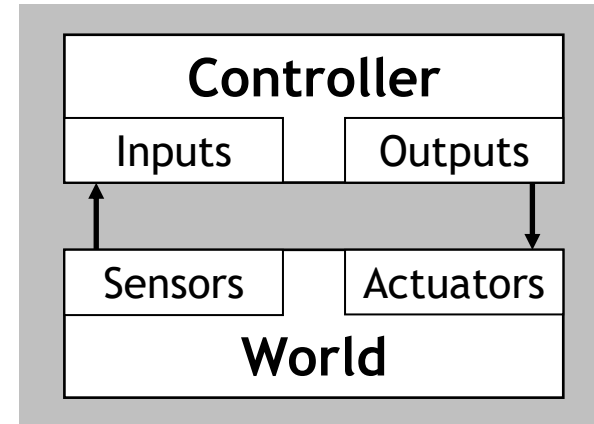


Obs: Language: English!

General stuff...

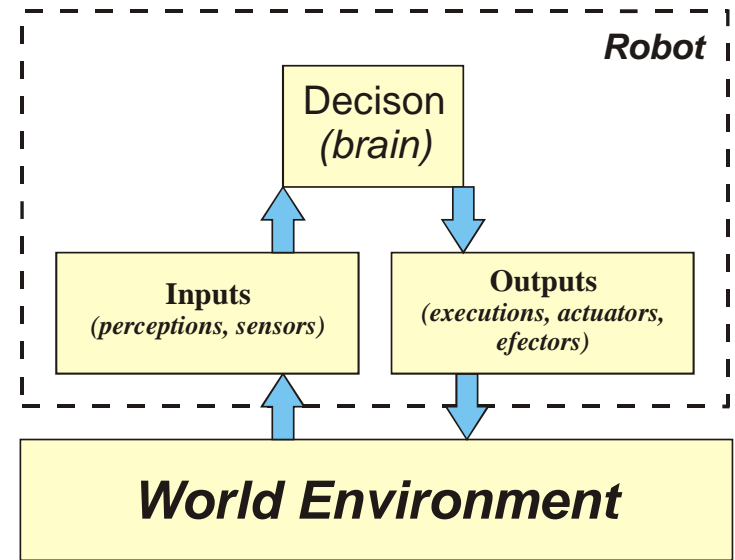
Automation & Robotics?

- Computer Driven apparatus
- Sensor Inputs
- Actuator Outputs
- Need for accuracy
- Safety!



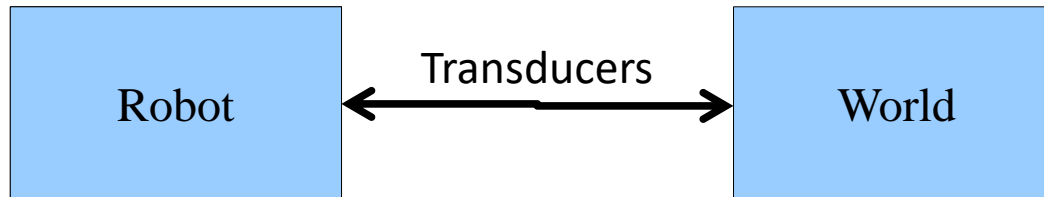
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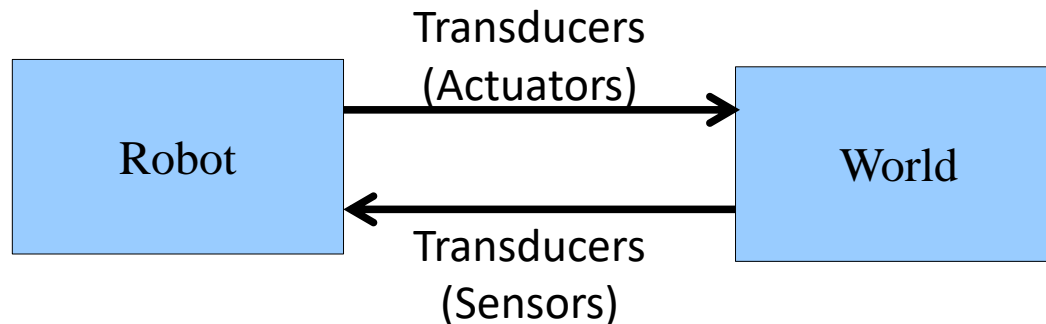
Robot & World

- The robot exchanges energy
 - Discover the world (Sense)
 - Change it (actuate)
- How ?
 - By using transducers that change energy forms



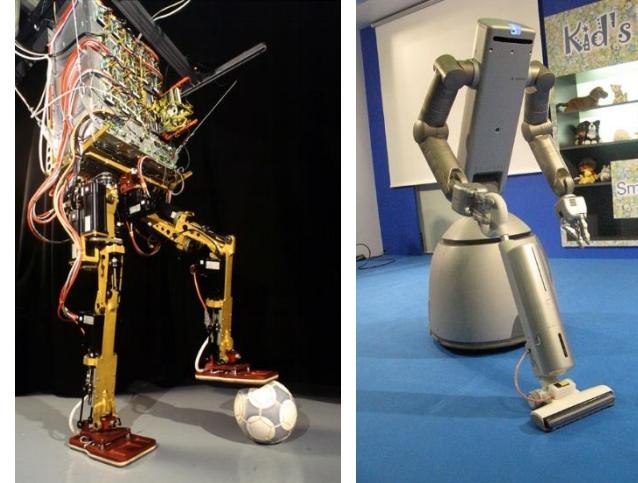
Sensors & Actuators

- Efeito de carga / “Toll” Effect ?
 - Does sensing change anything ???
- What is the **efficiency** of the change in the world ?
- How much energy is available ?
- Safety for the world (*humans!*) and the robot itself!

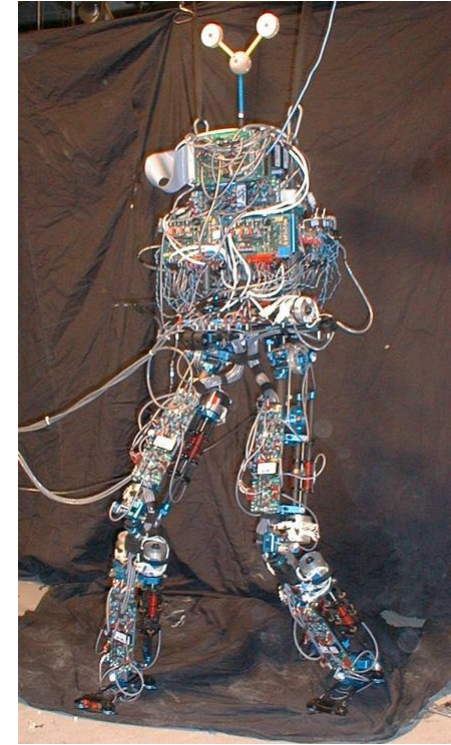
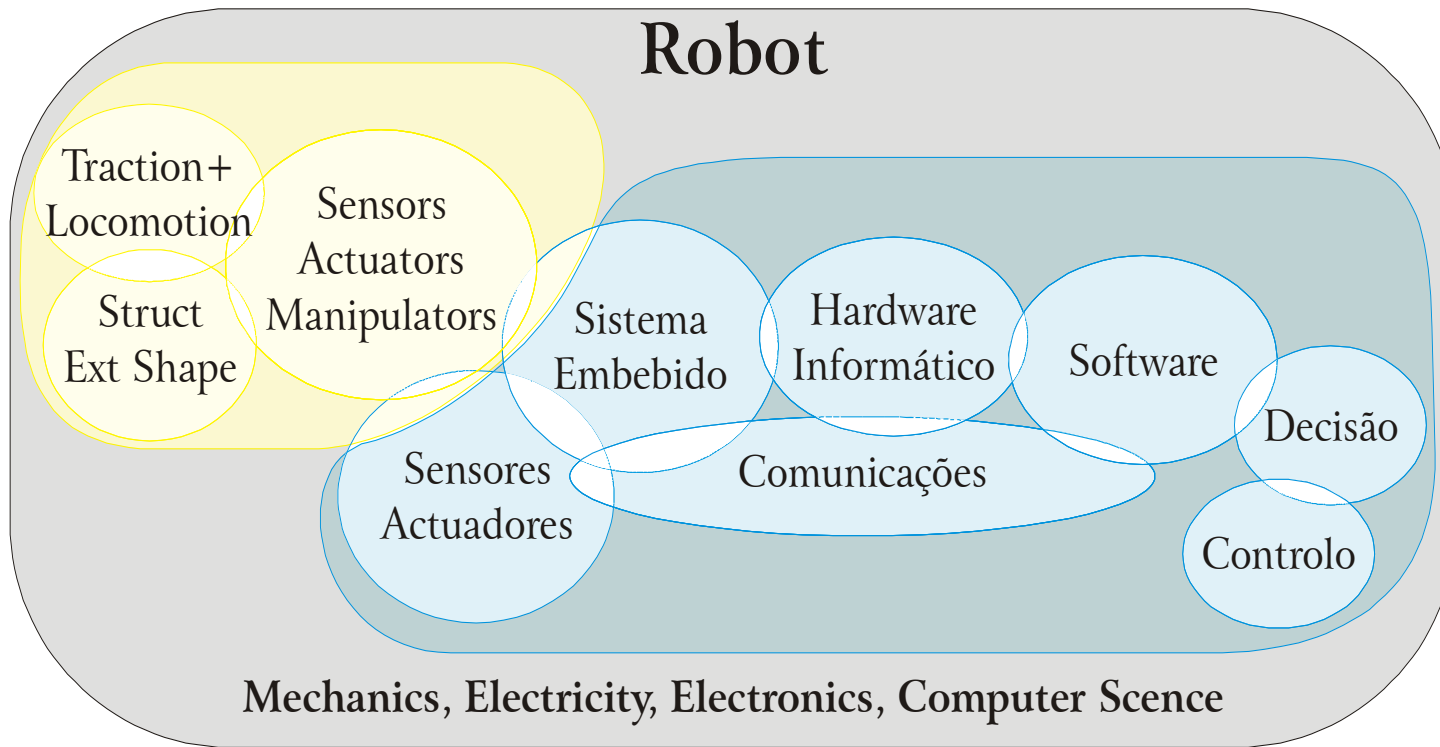


Autonomous Robots?

- Autonomous not as in mobile but as in:
 - Intelligent, flexible
 - Useful
 - True helper
 - World 😊



Robotics



**M2 robot,
year 2000**

[http://www.ai.mit.edu/
projects/leglab/
robots/robots.html](http://www.ai.mit.edu/projects/leglab/robots/robots.html)

[https://www.researchgate.net/
publication/
241503834_Design_of_a
bipedal_walking_robot](https://www.researchgate.net/publication/241503834_Design_of_a_bipedal_walking_robot)

Some of “FEUP’s” real robots 😊

Made by FEUP ;)

Robotic Soccer & RoboCup Federation

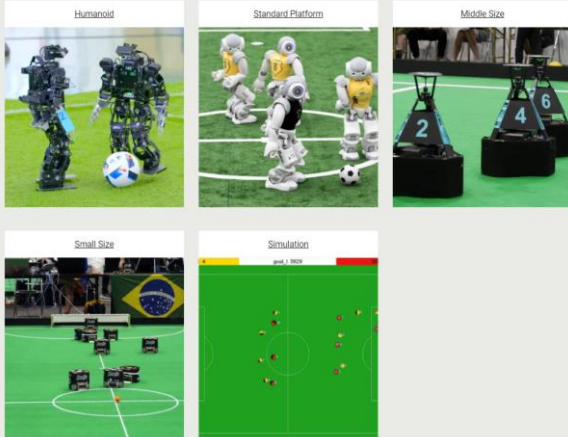
- Soccer:
 - Cooperative
 - Competitive
 - Real Time
 - *Interesting...*
- RoboCup:
 - Largest Federation
 - Standard Test Bench
 - Annual challenge
 - Global engineering challenge
 - Fully autonomous
- Several Leagues
 - Different focuses
- Annual change in rules to foster C&T achievements



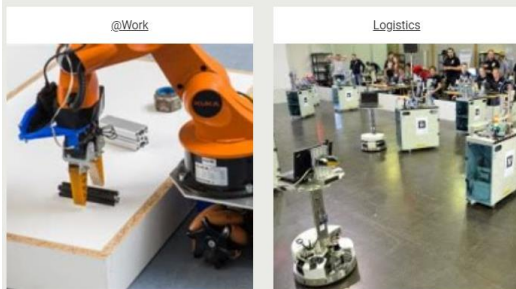
Robotic Soccer & RoboCup Federation



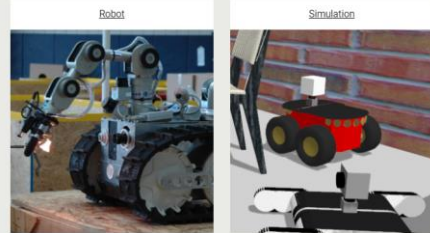
RoboCupSoccer Leagues



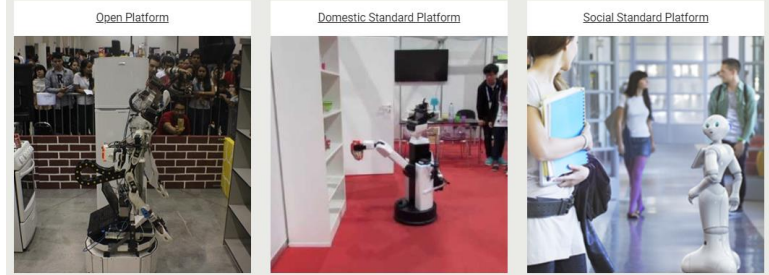
RoboCupIndustrial Leagues



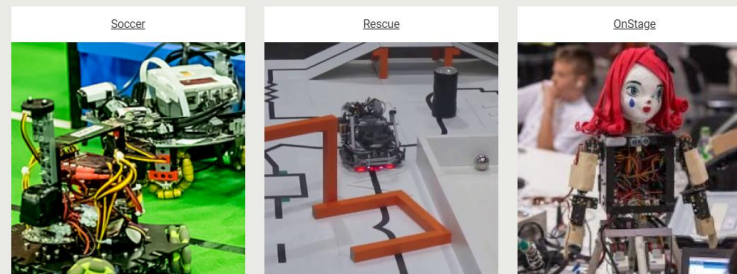
RoboCupRescue Leagues



RoboCup@Home Leagues



RoboCupJunior Leagues

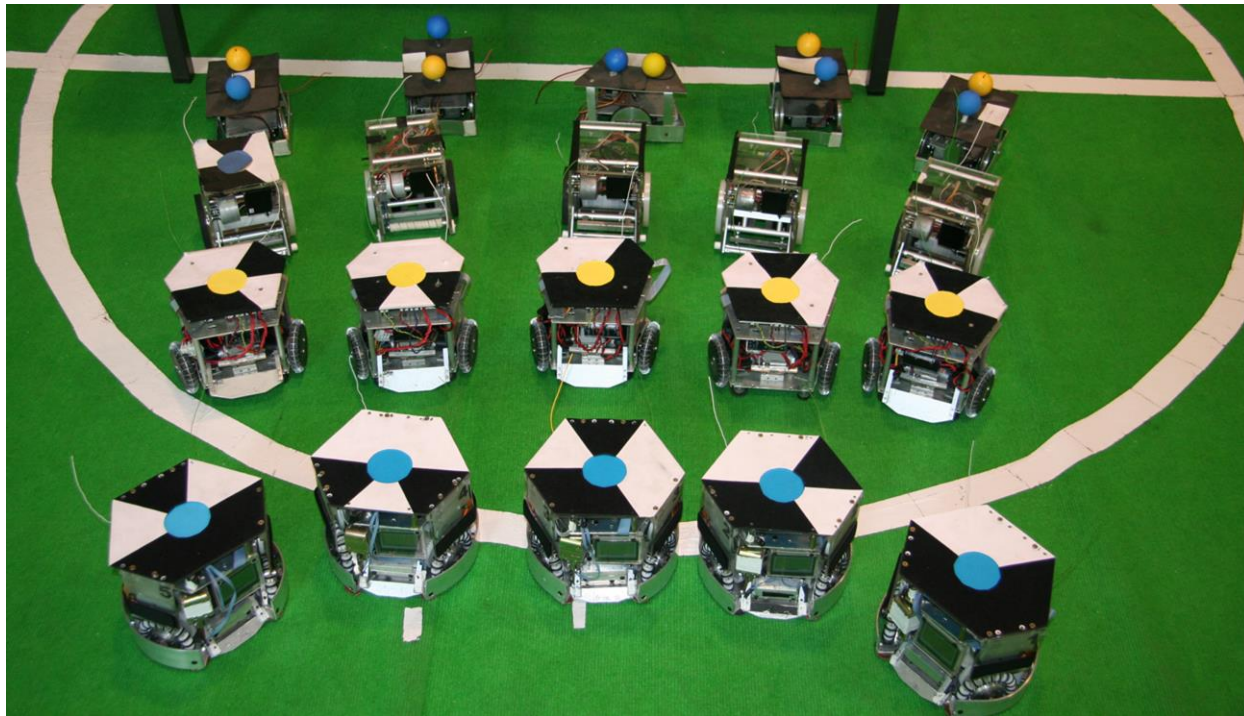


<https://2021.robocup.org/leagues>

RoboCup Soccer: Small Size League



Small Size League - History



1998

2006

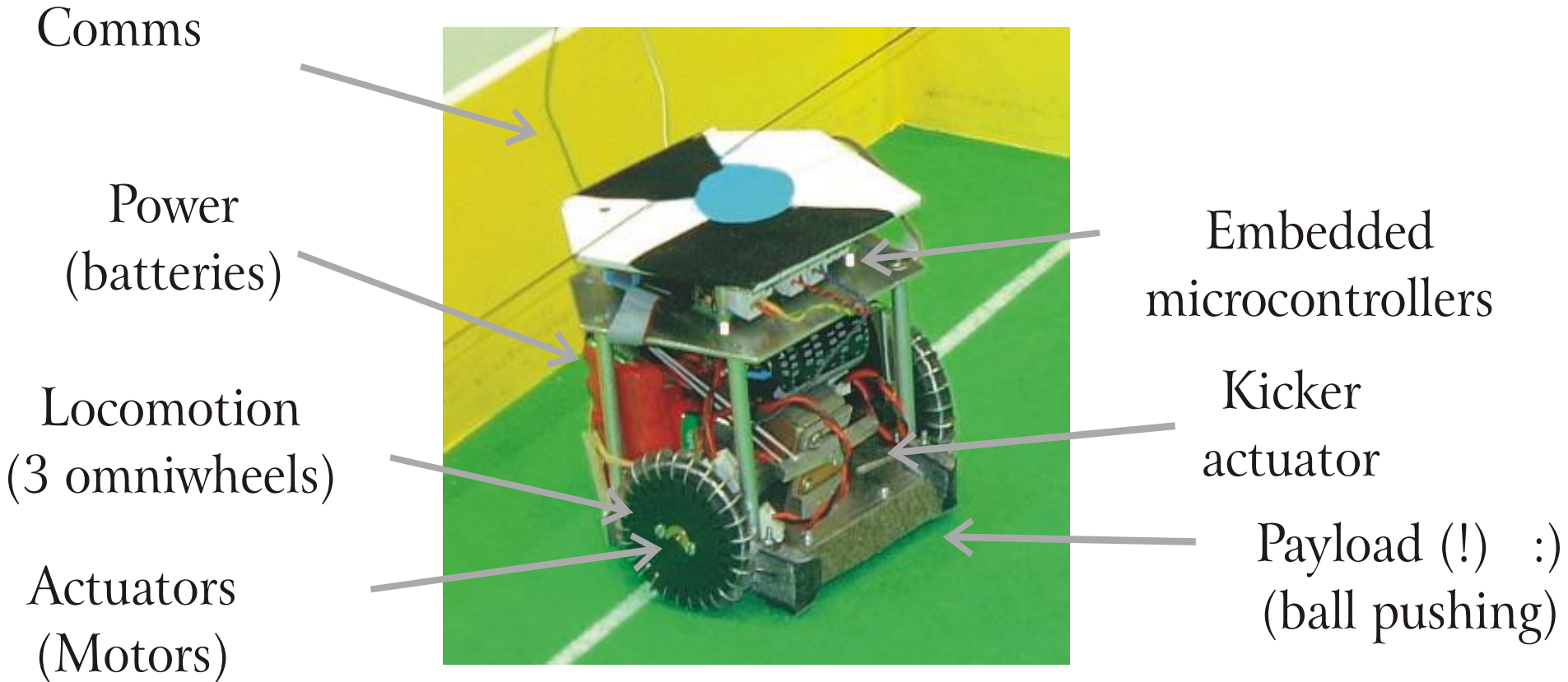


5dpo team from FEUP is Vice Champion of the world !!!

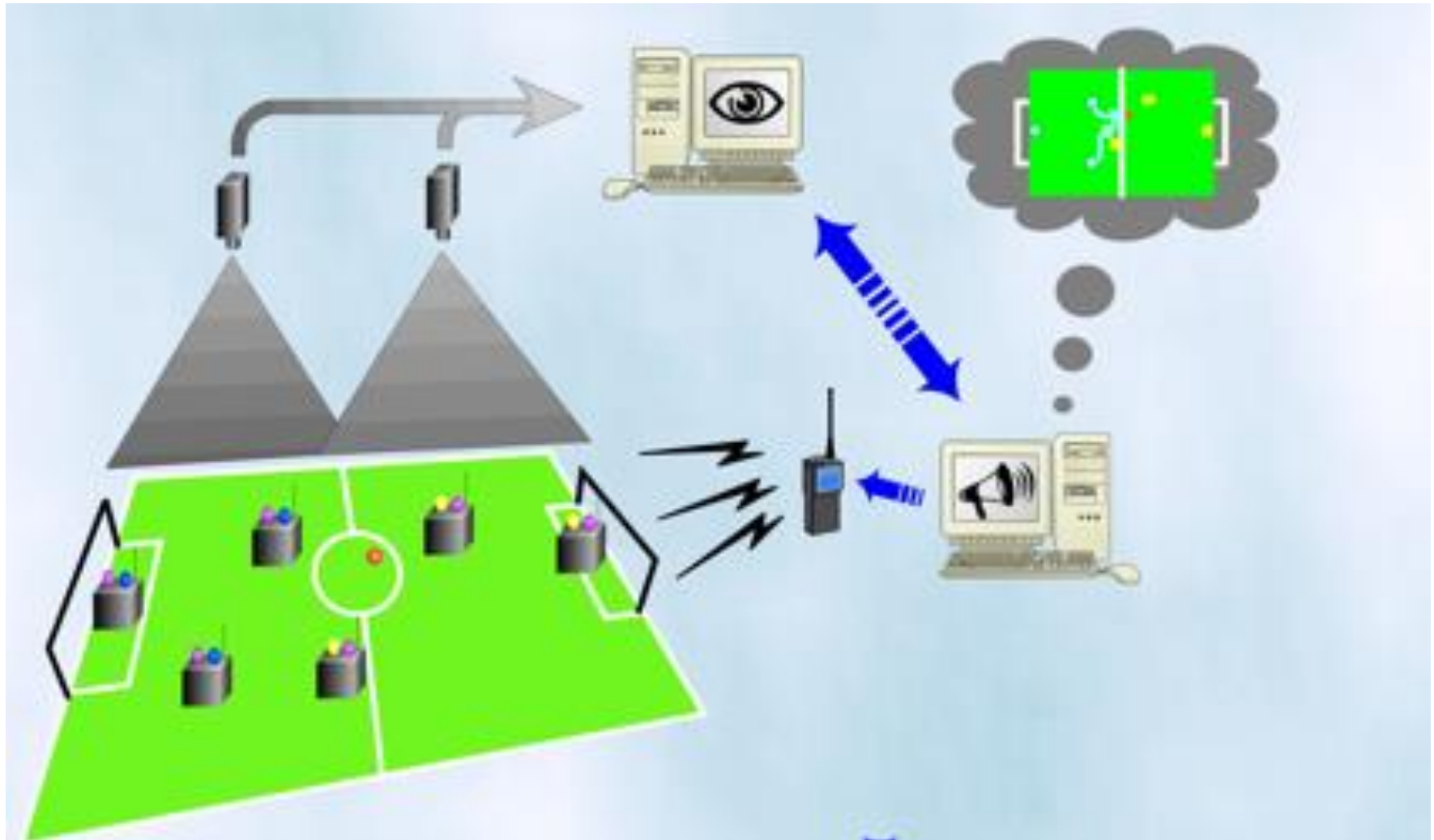
Small Size Looks



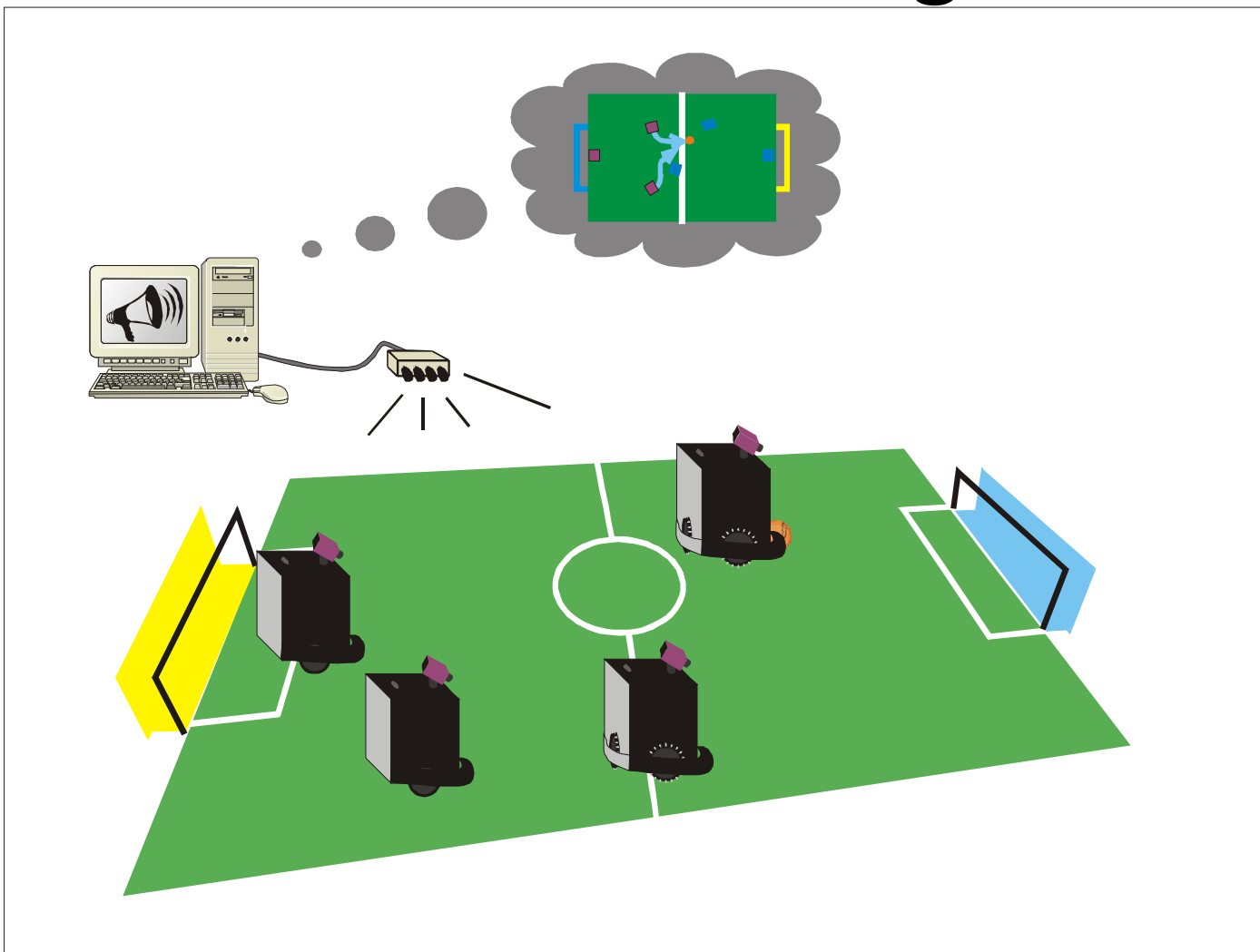
F180 “Small Size” Briefing



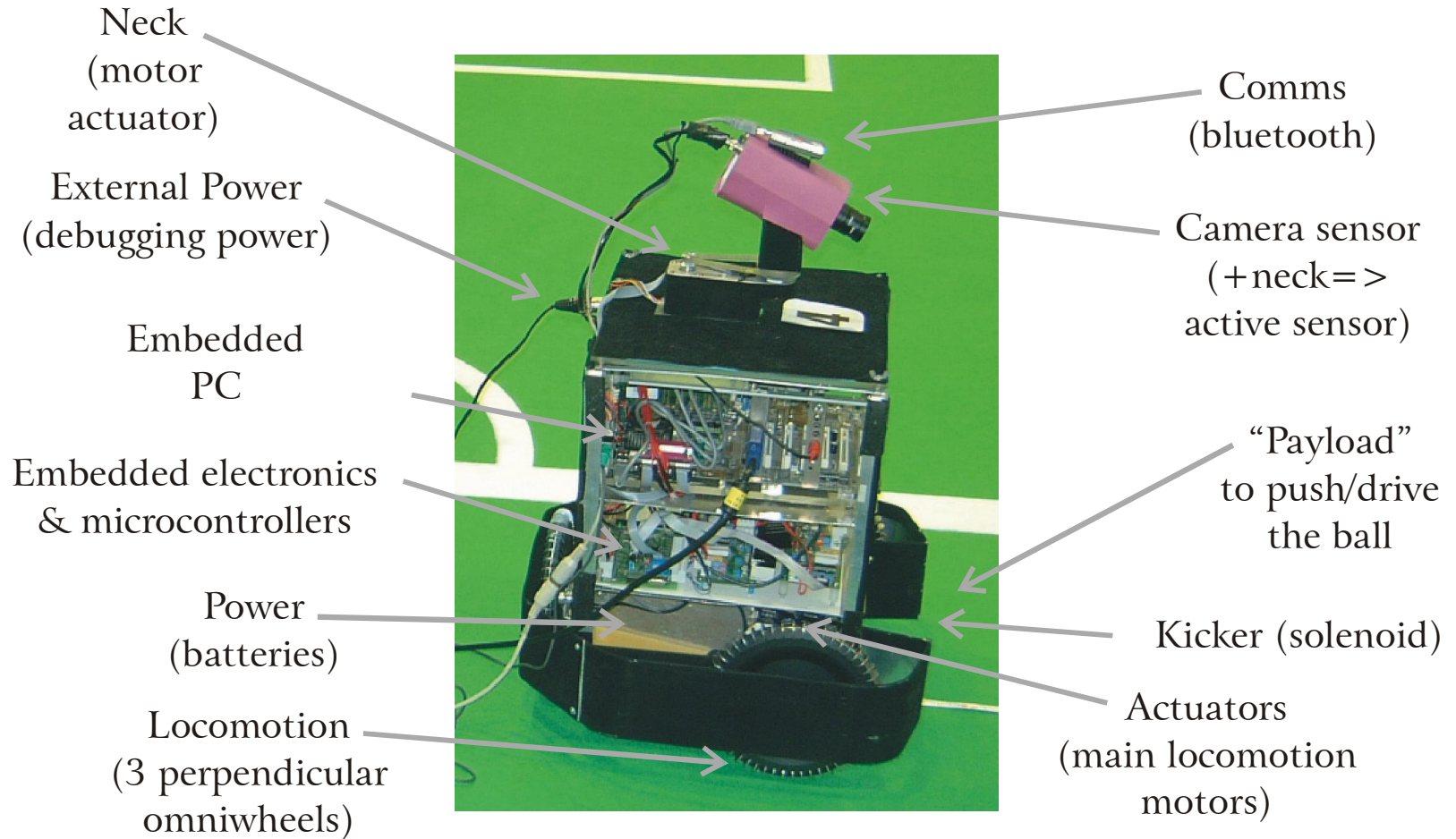
F180 “Small Size” Briefing



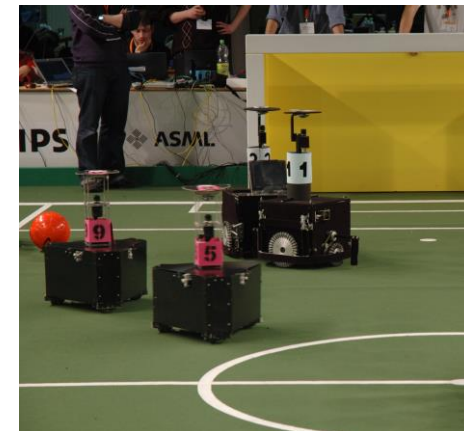
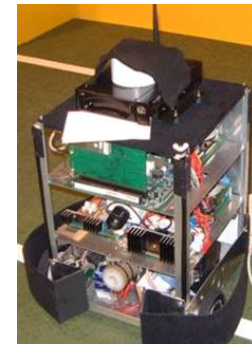
RoboCup Soccer: Medium Size League



Middle size robot briefing



Medium Size Looks & History



RoboCup – F180 & F2000

- *Leagues*
where 5dpo competes:
- **F180 - Small Size**
 - *Full engineering!!!*
 - *7 m x 5m + Golf Ball*
 - *Robot Size: ~18 cm*
- **F2000 - Medium Size**
 - *Autonomy!!!*
 - *12 x 18 m + Senior Soccer Ball*
 - *Robot Size: ~1 m*



Mostra UP 2010 (FEUP + INESCPorto)

Real World Robot...

What is a robot?

Robot

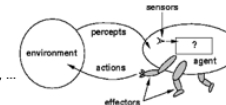
- What is an (autonomous) robot ?
 - Autonomy of decision
 - True “Helper”
 - Not so structured environment



- **Agent:**

- Perceive its environment using sensors and executes actions using its actuators

- Sensors:
 - Eyes, ears, nose, touch, ...
- Actuators:
 - Legs, Arms, hands, vocal cords, ...



- **Robotic Agent:**

- Sensors:
 - Cameras, sonar, infra-red, microphone
- Actuators:
 - Motors, manipulators, speakers

- Science and technology for **projecting, building, programming and using Robots**
- Study of **Robotic Agents (with body)**

- Increased Complexity:

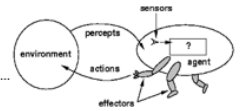
- **Environments:** Dynamic, Inaccessible, Continuous and Non Deterministic!
- Perception: **Vision, Sensor Fusion**
- Action: **Robot Control (Humanoids!)**
- **Robot Architecture** (Physical / Control)
- **Navigation** in unknown environments
- **Interaction** with other robots/humans
- **Multi-Robot Systems**



Robot – Definition

- Autonomous
 - Mobile
 - Intelligent
 - Embodied
 - Agent
 - Robot
-
- Environment...

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 - Sensors:
 - Eyes, ears, nose, touch, ...
 - Actuators:
 - Legs, Arms, hands, vocal cords, ...
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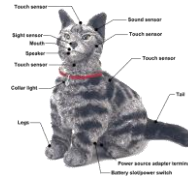
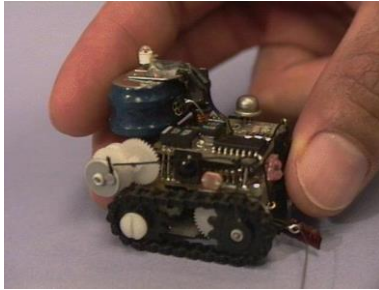
Not so autonomous (?)



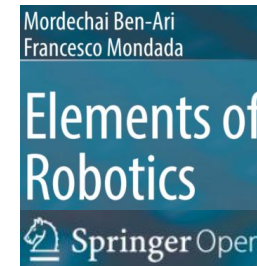
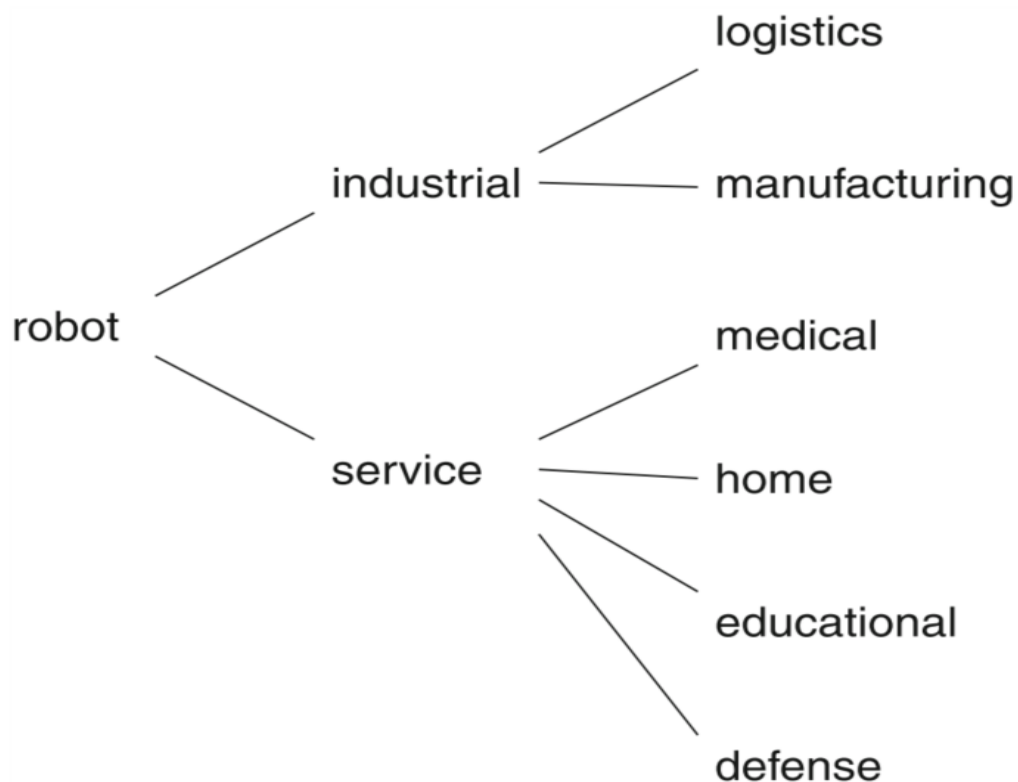
<https://youtu.be/mZ-L6FzX3yE?t=94>

Not so autonomous \leq Mostly actuators
(environments)

Tomorrow's robots of today

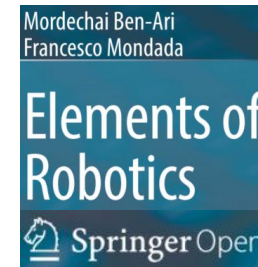
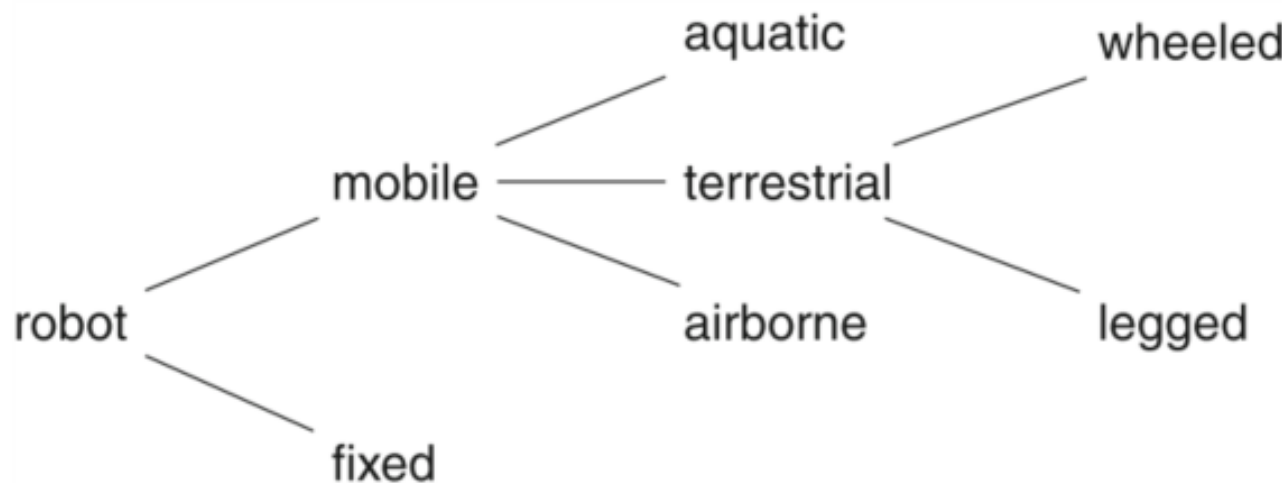


Robots - application field



<https://doi.org/10.1007/978-3-319-62533-1>
<http://creativecommons.org/licenses/by/4.0/>

Robots - environment and mechanism of interaction



<https://doi.org/10.1007/978-3-319-62533-1>
<http://creativecommons.org/licenses/by/4.0/>

Robot

R.U.R. is a 1920 [science-fiction](#) play by the Czech writer [Karel Čapek](#). "R.U.R." stands for *Rossumovi Univerzální Roboti* (Rossum's Universal Robots)
(...)

The play introduced the word [robot](#), which displaced older words such as "[automaton](#)" or "[android](#)" in languages around the world.

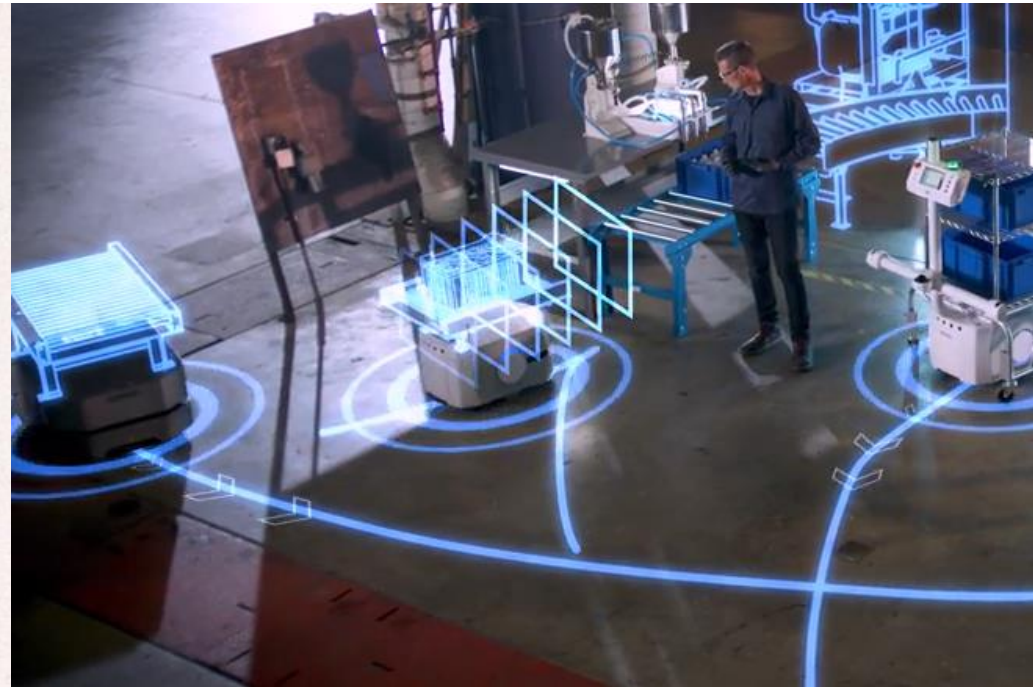
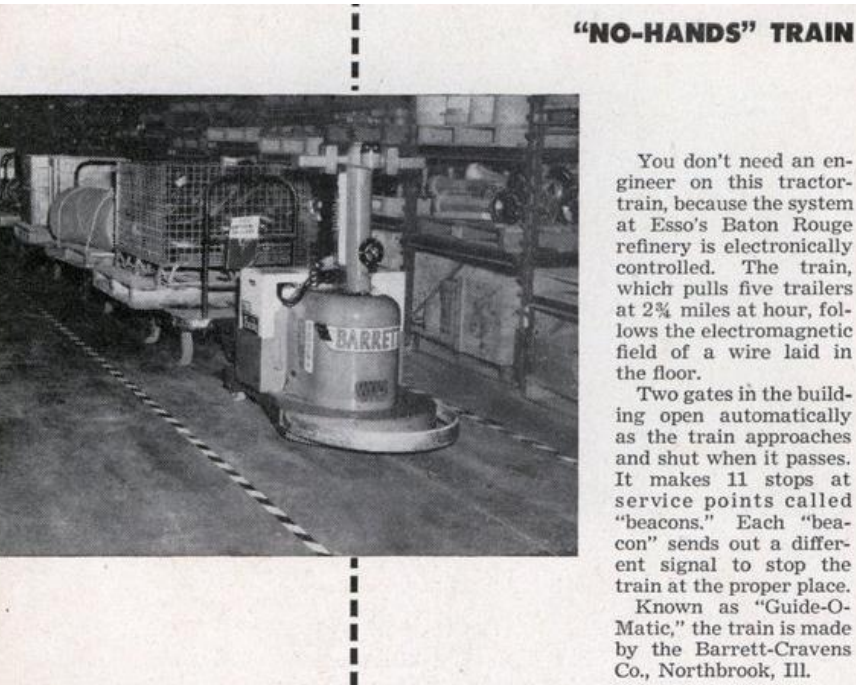
(...)
In Czech, *robota* means [forced labour](#) of the kind that [serfs](#) had to perform on their masters' lands and is derived from *rab*, meaning "slave".

<https://en.wikipedia.org/wiki/R.U.R.>

<https://en.wikipedia.org/w/index.php?title=R.U.R.&oldid=1106585699>

https://en.wikipedia.org/wiki/Three_Laws_of_Robotics

Automated Guided Vehicle (AGV)



1958 - “No hands train”
Barrett Electronics, USA
(now Savant Automation, USA)

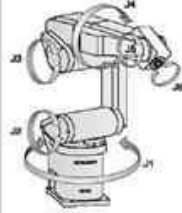





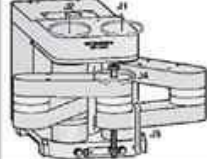








OMRON

[Link to file \(EIT CPPS 101 project\)](#)

Robotic Manipulator

Robotic “Arm”

<https://www.plantautomation-technology.com/articles/types-of-robots-based-on-configuration>

Principle	Kinematic Structure	Photo
Articulated Robot 		
SCARA Robot 		
SCARA Robot 		
Cartesian Robot 		
Parallel Robot 		

Mobile Manipulator



Mobile Manipulator

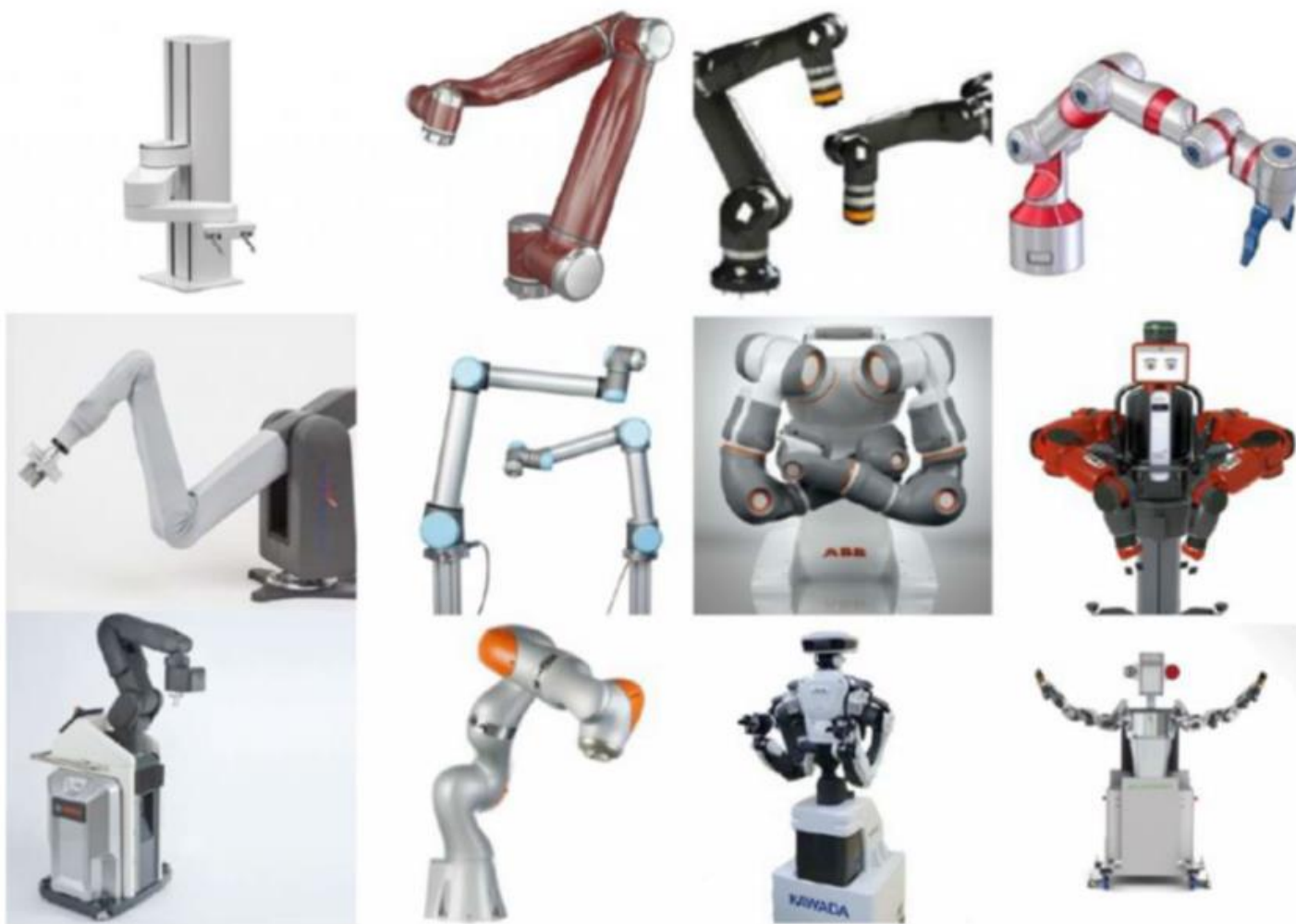
Robotic Arm



Mobile Platform

<https://youtu.be/7nNZriSZvVc>

Collaborative robot: COBOT



Cobots

As all the technologies, cobots are designed not only to work with humans but also to improve the productivity and efficiency.

There are five characteristics a cobot should have:

- 1) **Safety**: The first essential characteristic is to be safe around human. It is realized by the collaborative features according to the standards which will be discussed later.
- 2) **Light weight**: The second one is to be relatively light weight, so that they can be portable. In such a way that one cobot is suitable for multi tasks.
- 3) **Simplicity**: The third one is to be simple, which means operators do not need and background knowledge about programming to teach and work with them. Anyone, especially blue collar can easily work with a cobot.
- 4) **Low expenses**: The fourth one is to be cheaper for both acquirement of the cobot and the cost of maintenance and management than the traditional robots.
- 5) **Flexibility**: Last one is to be dexterous and flexible, with the innovation of new technologies, it allows cobot to have up to 7 DOF, one more than what was strictly necessary. It is this plus one DOF provides better configuration.

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