Robotica Mobile

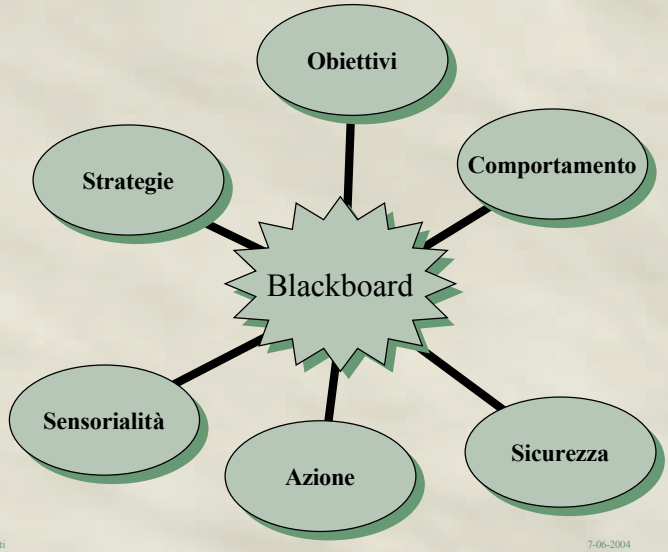
Lezione 20: Strutture di controllo di robot avanzati

Come costruire
un'architettura *BARCS*

7-06-2004

L'architettura BARCS

Behavioural Architecture Robot Control System



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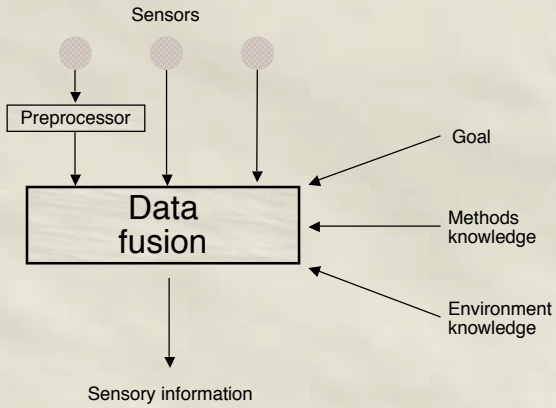
Purpose and strategy: the definition of actions

- The purpose can change during program execution (automatic sub-goals generation);
- All purposes must be “known” (for each purpose at least one strategy is required, or it must be possible to generate it);
- A strategy is a list of actions to be done to accomplish the purpose;
- Strategies generate incomplete plans, that must be refined and completed by other modules.

Behaviour: rules to be observed

- Behaviour contains rules the robot must always comply, in the form of instances that are added to the original plan.
- Behaviour solves the problems the planner cannot handle due to lack of information at planning time.

Sensoriality: getting information



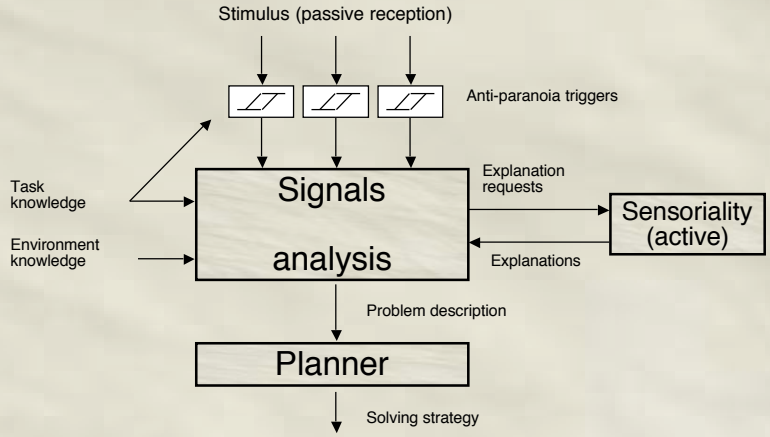
Robot sensing: very peculiar needs

- Pre-sensor processing
- Non conventional operators (e.g.: movement analysis)
- Use the movement of the sensor
- Condition the environment

Minimize processing ⇨ Minimize input data ⇨ Use best fit sensors

Not a general method, but many methods, each one tailored to different needs.
Enhance capabilities by enhancing knowledge, not processing power.

Safety: supervising actions



How does a BARCS machine behave

- When first turned on, it starts pursuing its goal with no need for programming;
- As soon as a target is seen, it will try to reach it, making a coarse plan of actions to be undertaken, and refining this plan according to encountered situations;
- Changing robot's applications will mean changing data bases in purpose and strategy modules.

Temporary goal: make the robot's job easier

- The environment:
  - The environment can be structured by means of easily recognizable symbols.
- The task:
  - If the robot is built to accomplish a limited class of tasks, dirty tricks can be employed to make its job easier.

⇒ *The robot does not have to make deep reasoning on its task: we are not building a philosopher robot.*

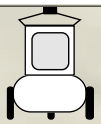
Intermediate results: goal-directed vision

- Goal:
  - Recognize and locate signposts;
- Problem:
  - Use inexpensive equipment and achieve very fast algorithms;

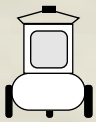
Identify easily recognizable shapes

Identify easily recognizable features

The first results:

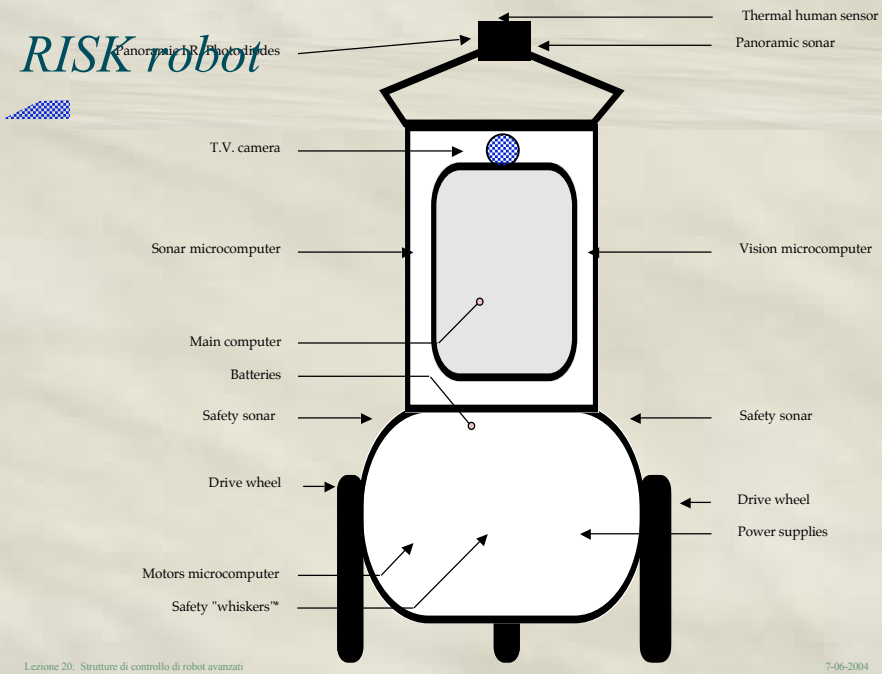


- Theoretical research:
- Definition of the architecture and of the individual modules
- Definition of behaviour and safety philosophy
- Definition of multi-sensor structure



Experimental research:
- *RISK* (*R*obot *I*n *S*hape of *K*ettle): experimental autonomous mobile robot
- Demonstration programs
- Ready to use partial results

RISK robot



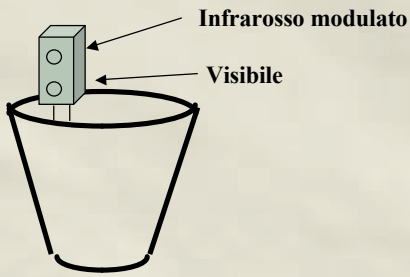
BARCS: a working example

Goal:	Approach the star and stop.
Strategy:	Locate the star and approach it until the distance is less than 50 cm; Locate an arrow and move in the direction indicated by the arrow.
Sensor strategy:	Use the stars and arrows detection algorithm.
Behaviour:	Before moving forward, check for free path. If it is not, generate “avoid obstacle” subgoal. Before turning, check for obstacles and apply “step forward - step backwards” rules.
Safety rules:	During movement, check for obstacles. If found, stop immediately.

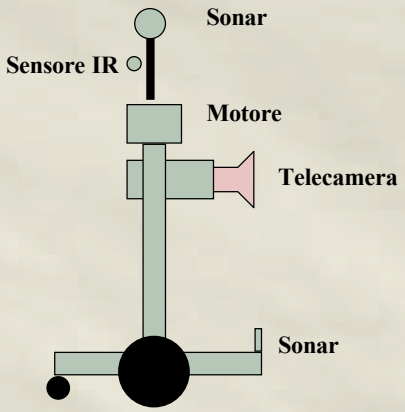
Esempio… semplice ma realistico

- Obiettivo:
  - Annaffiare le piante in ambiente domestico senza combinare disastri
- Prerequisiti:
  - Ogni pianta è dotata di un emettitore di luce che si accende quando la pianta ha bisogno di acqua
  - Il robot ha:
    - Rilevatore direzionale di luce
    - Sonar panoramico
    - Sonar anteriore
    - Rivelatore di contatto
    - Dispositivo di innaffiamento

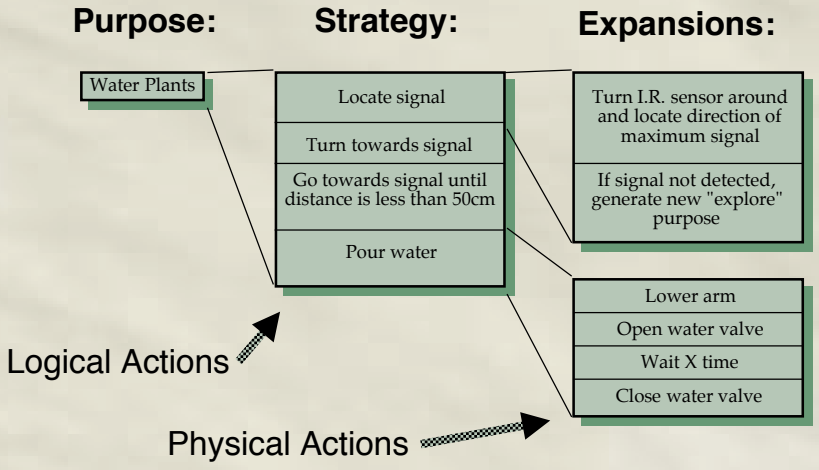
L'emettitore di luce:



I sensori:



BARCS: an example of operation



"Trick": each plant is identified by an I.R. L.E.D.

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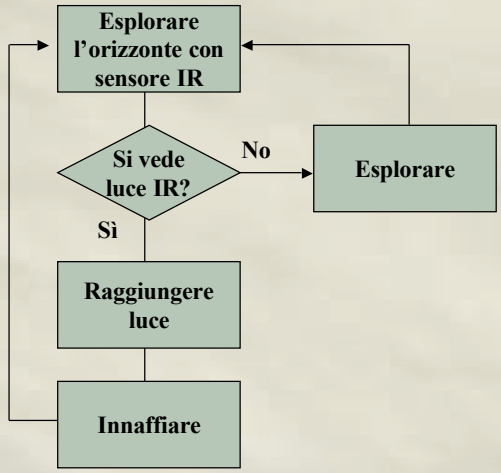
La strategia principale:

Obiettivo: cura piante



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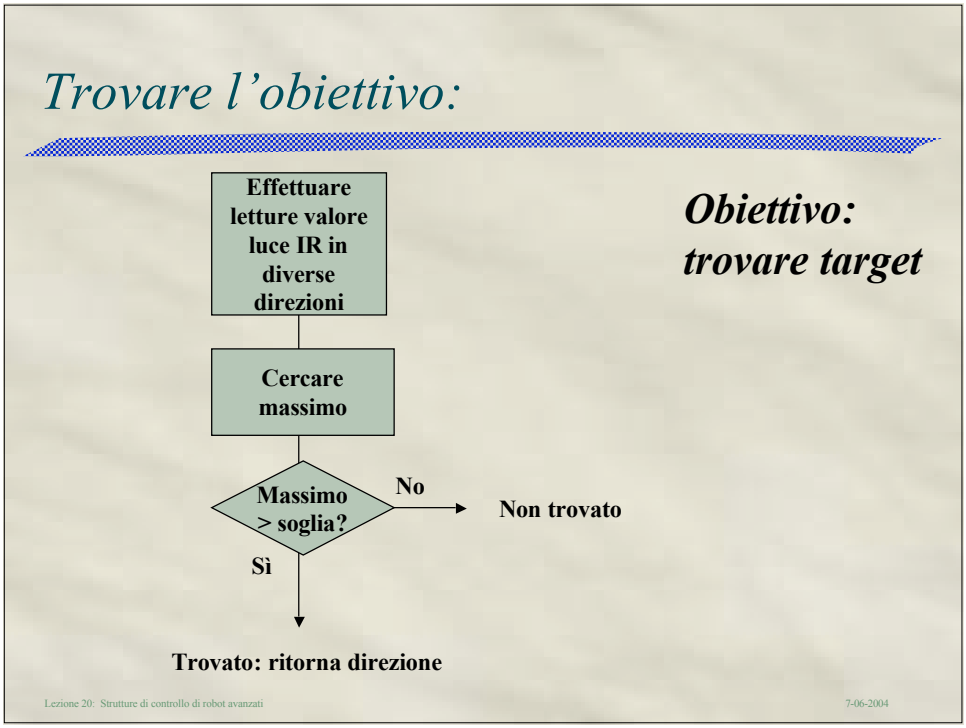
Trovare l'obiettivo:



Decomposizione degli obiettivi