

Introduction

For many years students and teachers in our school have worked in a laboratory which studies problems of “Artificial Intelligence”. Two years ago a group of students realized a project for which it was necessary to elaborate a map of the centre of Bolzano.

For this reason some members of the team completed the job walking around the area and recording the most important locations. After this experience some of us asked themselves if it was possible for an automatic system to execute such a repetitive and time-consuming operation.

We also meditated the importance that an automatic possibility of mapping a background could have, in case the location is inaccessible or full of unknown traps for humans.

We know that some automatic mapping systems already exist and that is why we decided to try to realize one which meets some particular requirements, formulated as questions:

- Is it possible to realize a cheap automatic system which maps effectively its surroundings?
- Is it possible that it works also in locations without GPS support?
- How can we make it usable to a user with normal technological competences?
- How can we make it modifiable to an expert user according to his specific needs?

To solve the problem of costs, we thought to limit the dimension and weight of the structure and only use free open source software to allow an expert user to modify the programs that determine the functioning of the system.

To increase the efficiency of the system, we realized three cooperating robots with similar structures which map the same site.

To optimize the cooperation among robots we examined many models, focusing in particular on strategies adopted by eusocial animals, like sharing of information and a rigorous hierarchy of the commands. The name of the project “Eusocial Rovers for Exploration” derives from this approach.

Each one of the three rovers, in fact, explores a part of the site sending the data of its position and the presence of rooms, walls and obstacles around it to a central server (which works like a queen-mother, center of the coordination of all the operations).

To acquire its own coordinates each robot records the number of the revolutions of each wheel, combined with the data that come from an accelerometer and a compass. To recognize doorways it analyzes images acquired with a web cam. Combining of all these various data, our rovers could even map locations without GPS coverage like locations underground, burrows and caves, etc.

The central server receives the geo-referenced data from the three rovers that in real time update a single database, through which the map of the until that moment explored site is created. After the first elaboration the system runs more steps to increase the precision, to correct the mistakes and to detect also some environmental parameters (for example temperature).

The representation continuously updates, also reporting the information of the recorded parameters and it can be visualized on the PC by an user who is connected to the server through a graphic interactive interface which allows to choose the kind of data to display.