Chapter 7

Autonomous Hexapod Robot With Artificial Vision and Remote Control by Myo–Electric Gestures: The Innovative Implementation Tale of gAltano

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ABSTRACT

The robot gAltano is an intelligent hexapod robot, able to move in an environment of unknown size and perform some autonomous actions. It uses the RoboRealm software in order to filter and recognize color blobs in its artificial vision stream, activate a script (VBScript in our case, or C or Python scripts) to compute decisions based on perception, and send the output to actuators using the PIP protocol. gAltano is thus a rational computerized agent: autonomous, or semi-autonomous when remote controlled; reactive; based on model (e.g., the line). gAltano moves in an environment which is partially observable, stochastic, semi-episodic, static, or semi-dynamic in case of human intervention, continuous both on perceptions and actions, multi-agent, because of human intervention that can have collaborative nature (e.g., when the human moves a block or the robot to increase his performance), or competitive (e.g., when the human moves a block or the robot to inhibit his performance).

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INTRODUCTION

In this project, an autonomous robot had been developed and tested in an unknown human-centred environment. The robot is part of the system both for complex autonomous tasks, independently managed by the robot directly (e.g., keeping the order of a place, following people at a certain distance), both for interactive tasks managed by the human controlling the robot via a mobile device or Myo-electric gestures (Oskoei & Hu, 2008) (e.g., moving the robot for unpredicted tasks).

Such a system must include considerations on heterogeneous problems, such as the acceptance of the robot appearance by the humans in the work environment. The UX (usability and accessibility) (Franzoni & Gervasi, 2009; Franzoni, Gervasi, Tasso, & Pallottelli, 2008) of the robot controlling system, the performance of the autonomous vision feature and objects recognition in an unknown environment, the optimal management of physical degrees of freedom of the motion parts, and the power saving optimization should be taken into account.

In this chapter, the technical background of the gAItano project is exposed, providing all the details of the technical implementation both hardware and software. For the hardware, particular attention will be dedicated to the needed parts both for the robot and for the features (e.g. camera control, remote control), and to the power. Regarding the software, particular attention will be dedicated to autonomous vision (Bonin-Font, Ortiz, & Oliver, 2008) development, including the artificial vision system, colour and camera management, coloured-object recognition, object relocation, motion control, providing pros and cons considerations on the proposed solution.

The gAItano robot is a simple real-time implementation of basic concepts for visual recognition of coloured objects. The algorithm is a baseline for understanding how a visual recognition algorithm may look like, and has a teaching and simplifying objective, more than a performance one: besides it is performing well on appropriate light, no systematic experimentation and performance evaluation has been done on the visual recognition. In the visual recognition direction, state of the art algorithm use deep learning to recognise not only the segmented object, but the object semantics. In such an approach, it is possible to use a well-trained model to exploit the benefits of having a high number of training images. More than this, the gAItano project can be seen as a complete teaching analysis by the Artificial Intelligence point of view of the problem of the robot vision and movement, taking into account all the steps of a robotics project in a real interactive environment.

HEXAPOD TECHNICAL SPECIFICATIONS

The robot built in this project, named “gAItano” (where AI stands for Artificial Intelligence, and Gaetano is the Italian name that the developers chose for the robot) is a hexapod robot, created using the kit MSR-H01 Mycromagic Systems. The MSR-H01 is an aluminium-body six-legged robot structure with excellent design, available until 2012 only, in a basic kit to which additional components had been added, e.g. micro-controller, servomotors, batteries, sensors, brain. This model has some appreciable features for Robotics and Artificial Intelligence goals: it is as big as a pet, it is light but robust, it includes an excellent basic micro-controller board, well programmed to allow smooth movements for all the 6 legs and 18 grades of freedom. It supports wireless communication and Bluetooth for remote control or data exchange.