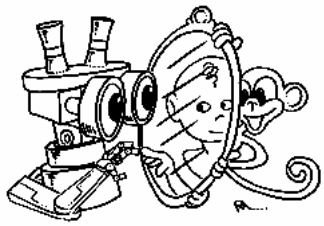

MIRROR

IST–2000-28159

Mirror Neurons based Object Recognition

Deliverable Item 1.6

Management Report N°:3

Covering period 1.9.2002-28.2.2003

Delivery Date: March 15, 2003

Classification: Internal

Responsible Person: Prof. Giulio Sandini – University of Genova

Partners Contributed: ALL

Contract Start Date: September 1st, 2001 Duration: 30 Months

Project Coordinator and Partners:

DIST - University of Genova (Prof. Giulio Sandini)

Department of Biomedical Sciences University of Ferrara (Prof. Luciano Fadiga)

Department of Psychology – University of Uppsala (Prof. Claes von Hofsten)

Istituto Superior Tecnico – Computer Vision Lab – Lisbon (Prof. Jose Santos-Victor)

Project funded by the European Community under the "Information Society Technologies" Programme (1998-2002)

Content list

1. Coordination and collaboration activities 2
2. Research activity 2
2.1. DIST - University of Genova 2
2.2. DBS – University of Ferrara 2
2.3. DP – University of Uppsala 3
2.4. ISR – Instituto Superior Tecnico in Lisbon 3
3. Deliverables 4
4. Effort in person hours in the period 4
5. Agenda of 3rd meeting - Ferrara October 18-19, 2002 5
6. Agenda of 4th meeting – Genoa February 21-22, 2003 6

1. Coordination and collaboration activities

During the first semester of the second year, two meeting were held.

The **third meeting** was scheduled was held in Ferrara on October 18-19 2002. All partners attended the meeting and presented progress on their scientific work. The second day of the meeting was devoted on the direction of further research. The agenda of the meeting is reported here.

More engineering aspects related to the robotic setup and the data-glove setup were discussed during the **fourth meeting** in Genoa on the 21-22, 2003. For this reason it involved DIST and IST as well as UNIFE. The main focus of this meeting was to discuss the computational model of mirror neurons and to define the experiments of data acquisition to be carried out with the data-glove setup. After the meeting DIST started the data recording of grasps performed by humans.

Throughout the period between the two meetings there was active cooperation between the partners by e-mails and phone calls. This was very important in preparation of the fourth meeting.

The research in this semester proceeded as planned. It is now possible to start the experiments with the data-glove setup in a systematic fashion. This data will be used to test the computational model of mirror neurons during the next semester.

2. Research activity

The following sections describe the research activity of each partner.

2.1. DIST - University of Genova

1) Realization of the robotic hand. The hand has 16 joints and 6 controlled degrees of freedom. Joints are coupled through elastic elements in order to offer intrinsic safety and compliance. Compliance can be used when grasping to get an approximate estimation of the shape and size of the object.

2) Robot hand software development. The hand is connected to a control board; it is possible to control each degree of freedom in position as well as velocity mode. Magnetic encoders are connected to an analog-digital converter; together with the motor optical encoders they provide position feedback.

3) Recording and experiments. We have started to acquire data with the data-glove setup in a systematic way.

References:

G. Metta and P. Fitzpatrick. *Early Integration of Vision and Manipulation.* Adaptive Behavior special issue on Epigenetic Robotics. Vol 11 Issue 2 (2002) pp. 109-128.

L. Natale, S. Rao, G. Sandini. *Learning to act on objects. 2nd Workshop on Biologically Motivated Computer Vision (BMCV).* Tübingen (Germany), November 22-24, 2002

2.2. DBS – University of Ferrara

1) Monkey experiments: The goal of these experiments is to establish if F5 premotor neurons are sensitive to the vision of monkey's own acting hand. This because one possible explanation of the origin of mirror neurons is that they might have developed from the visual feedback system that visually controls grasping execution. There were four experimental conditions: grasping in light, grasping in dark, grasping in dark with a brief visual feedback of

the grasping hand touching the object, grasping in dark with a brief visual feedback of the grasping hand before touching the object.

3) Mirror system and communication: we are investigating in humans how the mirror system could be involved in communication. We are preparing experiments to investigate the role of premotor cortex in speech perception.

References:

Craighero L. Bello A., Fadiga L., Rizzolatti G., *Hand action preparation influences the responses to hand pictures*, Neuropsychologia, Amsterdam, 2002, 40: 492-502.

Gallese V., Fadiga L., Fogassi L., Rizzolatti G. *Action representation and the inferior parietal lobule. In: Common Mechanisms in Perception and Action* - Attention and Performance - Volume XIX. Eds. Prinz W. e Hommel B. (New York: Oxford University Press) 2002.

Rizzolatti G., Fadiga L., Fogassi L., Gallese V. *From mirror neurons to imitation: facts and speculations.* In: The Imitative Mind Development, Evolution and Brain Bases. Eds. Meltzoff A.N., Prinz W. (Cambridge: CUP (Cambridge studies in cognitive perceptual development), 2002

2.3. DP – University of Uppsala

In this semester UU has worked on problems related to the development of manual control.

1. Children's ability to adjust the orientation of objects with various shapes in order to fit them into holes is studied. This project was begun during Y1. The experiments utilize the natural interest of young children in fitting objects into holes. By varying the form of the objects and the holes, the difficulty of the task can be manipulated. Pre-adjustments of the orientation of the various objects before trying to push them through the holes, give information about the subjects spatial cognition as well as their ability to plan these actions. Some experiments have been completed an others are planned.
2. An experimental paradigm has been established to the development of infants' predictive reaching for moving objects. Two orthogonal servomotors drive an object on a 1 x 1 m planar surface. The motors are placed behind the surface and transmit the motion to the object magnetically. We have been working on the software in order to be able to construct any almost arbitrary motion with any velocity profile. The device is going to be used to explore predictive reaching and the development of extrapolation rules in infant catching.

2.4. ISR – Instituto Superior Tecnico in Lisbon

Efforts have been devoted to developing a methodology for gesture recognition exploiting motor information as well as visual data. A possible approach consists in a Visuo-Motor Map (VMM) that establishes an association between the appearance of images of a hand and the corresponding motor information. The classification strategy encompasses also the affordances of each manipulated object in the sense of coding the likelihood of different grasp types for different objects. It is assumed that affordances are learnt *a priori* even if the model allows for updating the affordance representation.

We have been testing the training on preliminary data from the data-glove experiments. We plan to test the system more extensively on the data that will be recorded by DIST.

References:

Raquel Vassallo, José Santos-Victor, Hans-Jorg Schnebeli, "Using Motor Representations for Topological Mapping and Navigation," Intl. Conference on Intelligent Robots and Systems, IROS 2002, Lausanne, Switzerland, October 2002,

3. Deliverables

The following table lists all the deliverables due at month 18.

Num.	Deliverable Name	Lead	Type	Due
1.6	Management Report 3	DIST	Report	18
2.5	Architecture of the learning artifact	DIST	Report	18 (delayed)
3.4	Modeling of the mirror neurons representation	DIST	Report	18 (delayed)

4. Effort in person hours in the period

Contractors	Person Hours Y1	Person Hours for the reporting period
Coordinator DIST	1887	1598
Contractor UNIFE	2258	1551
Contractor UU	2880.5	2001
Contractor IST	2023.41	1021
TOTAL	**9,048.91**	**6,171.0**

More detailed cost breakdown will be reported in the Management Report 4 due on month 24.

5. Agenda of 3rd meeting - Ferrara October 18-19, 2002

October 18, 2002

9:00 Welcome

9:15: Technical Presentations

Uppsala – Claes von Hofsten and Kerstin Rosander

UNIFE – Luciano Fadiga and Laila Craighero

LIRA-Lab, “Learning to act on objects: A multisensory approach “, Lorenzo Natale

LIRA-Lab, “A new kind of manipulation”, Giorgio Metta

LIRA-Lab, “Experimental set-up for the study of mirror-based grasping in humans”, Matteo Schenatti

UNIFE – Maddalena Fabbri Destro

Discussion

October 19, 2002

9:00 Management meeting

10:00 Technical/Scientific discussion

Attendees:

DIST: Giorgio Metta, Lorenzo Natale, Sajit Rao, Giulio Sandini, Matteo Schenatti

Universty of Uppsala: Claes von Hofsten, Kertsin Rosander

University of Ferrara: Laila Craighero , Luciano Fadiga, Maddalena Fabbri Destro

IST-Lisbon: Alex Bernardino, Manuel Cabibo Lopes , Josè Santos-Victor

6. Agenda of 4th meeting – Genoa February 21-22, 2003

February 21, 2003

9:00 Welcome

9:15 IST, "Modeling the mirror neuron representation", Alexandre Bernardino, Manuel Lopes, José Santos-Victor.

10:30 DIST, "First experiments on the data glove setup", Matteo Schenatti

11:30 Discussion

February 22, 2003

9:00: Discussion

Attendees:

DIST: Giorgio Metta, Lorenzo Natale, Sajit Rao, Giulio Sandini, Matteo Schenatti

UNIFE – Luciano Fadiga

IST – Alexandre Bernardino, Manuel Lopes, José Santos-Victor