Deliverable D9.3

"First version of integrated companions"

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LIving with Robots and intEractive Companions

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1. Purpose of the document

This document serves to showcase the first versions of the integrated companions developed within LIREC. The consortium agreed that the best way to present this particular deliverable was by providing links to web resources displaying videos of these prototype integrated systems in actual operation in the showcase scenarios. This approach serves a dual purpose of demonstrating the project's progress rather than simply writing about it and in addition supplies a valuable project resource of multimedia dissemination materials. This resource will assist significantly both in the project's press and public engagement work and help support our industry engagement strategy.

In this short accompanying summary document we briefly report on the key advances of the integration software architecture that was previously described on in deliverables D9.1 and D9.2. The architecture and the developed capabilities demonstrated in the videos were also motivated by the psychological theory (WP2) and dog ethology studies (WP7) as described later in Appendix A and Appendix B.

2. Integrated Companions

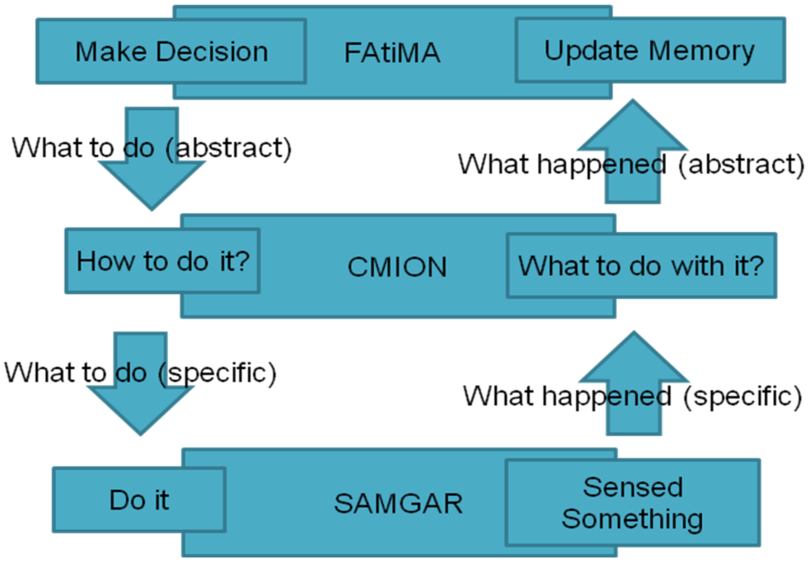
The behaviour of the first integrated companions can be best demonstrated through video. For this purpose we have prepared a website with video resources and textual descriptions at http://www.lirec.org/first-integrated-companions. On this weblink we demonstrate the working of the first integrated companion showcases from partners INESC - MyFriend (in iCat robot and mobile phone embodiment), UH - Robot House (pioneer robot and AIBO embodiment), HWU - Spirit Of The Building (pioneer robot and virtual character embodiment) and WRUT (FLASH robot platform) are covered. In addition to the videos, we have also provided the source code for these examples on the Lirec SVN server and on the URL http://trac.lirec.eu/browser/scenarios

3. Integration Architecture

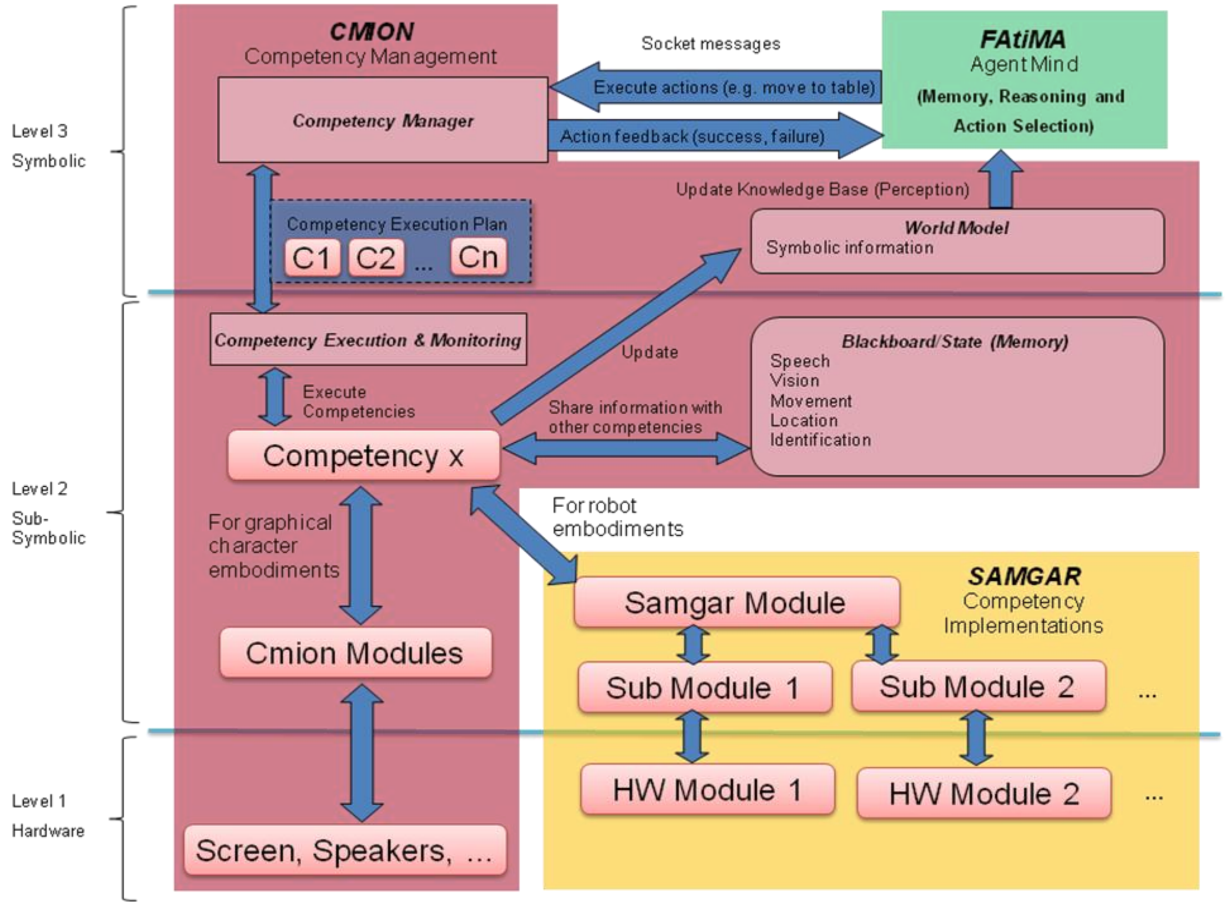
One of the goals of WP9 is the development of a generic software architecture for companions that can allow the migration of a companion's personality between different embodiments and the sharing of competencies between project partners. The design of this architecture applies the 3 layer approach of classic robotic architectures and has been described in deliverables D9.1 and D9.2. The design described in those earlier deliverables has now been implemented in a complete system, consisting of 3 components that mirror the 3 conceptual layers:

- **FAtiMA** (layer 3): The agent's mind responsible for decision making, planning and emotions. Development of this component is part of WP5. The memory mechanisms developed in WP4 are also integrated within FAtiMA. FAtiMA is implemented in Java and development is lead by INESC-ID. The source code can be found on http://trac.lirec.eu/browser/AgentMind
- **CMION** (linking layers 3 and 2): The main purpose of this system is the translation of symbolic to sub-symblolic information and vice versa. That means CMION is responsible for selecting concrete competencies to perform symbolic commands selected by the mind and providing symbolic perception inputs to the mind. CMION is written in JAVA and built on top of INESC-ID's ION framework. Development is coordinated by Heriot Watt University. The source code can be found on http://trac.lirec.eu/browser/libs/cmion
- **SAMGAR** (linking layers 2 and 1): SAMGAR provides an easy way to connect, distribute and migrate competencies (http://trac.lirec.eu/browser/level2/competencies), especially those for robotic embodiments where real time issues are of a great concern [1]. It provides monitoring, error handling and recovery functionalities for increased stability in cases where individual competencies fail or crash. Samgar uses the YARP platform and is written in C++. SAMGAR is developed by University of Hertfordshire, detail overview on SAMGAR was provided in deliverable D9.2. The source code can be found on http://trac.lirec.eu/browser/libs/Samgar

The following diagram gives a high level overview of the interplay between the 3 components:



The next diagram explains in more technical detail how the architecture components are connected:



The consortium is at a stage now were all this technology is in place and connections between the 3 different components have been established. All of the first integrated companion versions featured in this deliverable use some parts of the technology showcased here. The showcase in Heriot Watt University, Team Buddy has the first implementation example of applying the whole architecture, i.e. making use of all the 3 systems (FAtiMA, Cmion and Samgar). The implementation process for the team buddy has been documented and serves as a tutorial for other partners of how to use and apply the architecture. The source code for this first integrated example can be found at http://trac.lirec.eu/browser/scenarios/TeamBuddy. Based on this, other scenario implementations will now be gradually modified to use all of the architecture. This helps establishing an iterative design loop where experience of applying the architecture to scenario implementations feeds back into improving the architecture. A detailed description of the architecture will be delivered in D9.4.

4. References

[1] https://uhra.herts.ac.uk/dspace/bitstream/2299/3876/1/903556.pdf

Appendix A Toward an ethology-motivated design (WP7, EOTETO)

The role of ethology in LIREC is to identify possible scenarios within the showcase, replicate the behavioural interaction with human and dog, and provide a behavioural model for the dog's part in this interaction. This behavioural model is used to inform designers of the robot behaviour in order to improve (enrich) the behavioural capacities of the artificial agent. It is important that the interaction of human and dog should not be constrained by the scenario, that is, they should display naturally-occurring variability (richness) in social behaviour. For the future these scenarios serve as tools for comparison of human-dog and human-robot comparisons.

It is important to understand that behavioural modelling provides an input to robot control at various levels. First, observations implicate the need for novel pattern of behaviour or novel ways of interaction in order to enrich the behaviour output of the robot. Second, behavioural observations could help in setting the parameters of the model controlling the robot. Third, detailed study of behaviour could provide alternative models for representing potential subsystems in the robot, and also by revealing important relationships between different subsystems. Fourth, ethological observations on personality can not only contribute to the individualisation of robotic behaviour but also make the system more robust. Finally, temporal models of behaviour may help to fine-tune of social interaction with regard of the mutually expected dynamics of behavioural exchange.

Accordingly the behavioural models of dog-human interaction will rely on these three fundamental aspects. In contrast to previous approaches we offered a quantitative approach which is based on actual behaviours performed by the dog (and the human) during the interaction. The challenge is whether a detailed description of controlling systems can be modelled without much a priori assumptions about behaviour.

This work has been started by the detailed analysis reported in D7.3., section 6.3. This consists of a series of behavioural test which relate directly to the human-robot interaction in the showcases. We have also started to validate from an ethological point of view the scenarios by indentifying robots' capacities in terms of perception, behaviour, cognition (and autonomy). This will help in finding problems in the believability of the scenarios before actually put them to test. This discussion has already revealed several points for consideration how the robot's behaviour might be changed. Continuous feedback between the engineers and the ethologists is expected as the robot is equipped with novel skills, and as the details of social interaction in the ethological experiments emerge.

Appendix B Integrating companion development from a psychological perspective (WP2, Bamberg)

From a psychological perspective, the LIREC team tries to focus on the user in order to investigate long-term relationships towards the robotic companions. In particular, we investigate how to design scenarios and companions such as to best meet “user goals”, taking an explicitly general-psychological stance. The target variable in the psychological approach is the user satisfaction as core indicator of the quality of interaction. Although simplified, user satisfaction is preliminarily defined as a function of the achievement of user goals which is considered as a core precondition for building long-term relationships.

Basic human **needs** such as those taken from Dörner’s PSI theory (e.g. 1998) or Fiske’s social motives (2004) are considered as underlying all human behaviour via goals. User **goals** can be traced back to almost any combination of these needs and are also highly specific to task and situation, since they are triggered by expectations regarding the companion and the context. We want to distinguish between functional goals (goals that are related to the task the companions is designed to do in a certain scenario) and social goals (goals that describe how the companion should “do things”; Dautenhahn, 2007). It is assumed that human beings always have goals and typically more than one goal at a time. Goals vary in their importance over time. They emerge and fade, due to achievement, time passing, or certain events.

In principle, there are two ways of satisfying user goals in human companion interaction: first, the companion is able to complete tasks corresponding to user goals, and second, the user goals can be actively „pushed” in the direction of realisability. The latter aims at designing the context (task) and the companion itself in such a way as to suggest which goals can be achieved in certain situations and how the companion can support the user to achieve certain goals. Informing the design process early on can thus help the user satisfaction later on. The two main psychological research questions are thus (1) Which goals do users have? and (2) How can companions help satisfying them?

In the current phase of LIREC, hypothetical reasoning regarding user goals and their dependency on context / situation and companion appearance may serve as a source of information in carefully extending the scenario description and the companion design process.

References:

Dörner, D. (1998): Bauplan für eine Seele. Reinbeck: Rowohlt Verlag.
Fiske, S. T. (2004) Social Beings: A Core Motives Approach to Social Psychology. New York: John Wiley & Sons.