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PARTENAIRES	ISIR, LAAS
DATE	T0+36

Contents

1 Summary

The RoboErgoSum project employs a cognitive architecture designed for providing a robot with the necessary skills for autonomous activity in an unknown environment. The current software architecture used for the experimental validation of the project is presented in Fig. 1.

The modules present in this architecture have been developped by both teams involved in the RoboErgoSum project: ISIR (sensorial perception; sensorimotor learning for affordance acquisition; motor control; motivation; reinforcement learning model-free decision making system), and LAAS (sensorial perception and motor control; spatial reasoning and knowledge, the symbolic knowledge base; human-aware task planning, human-aware motion and manipulation planning; the supervision system).

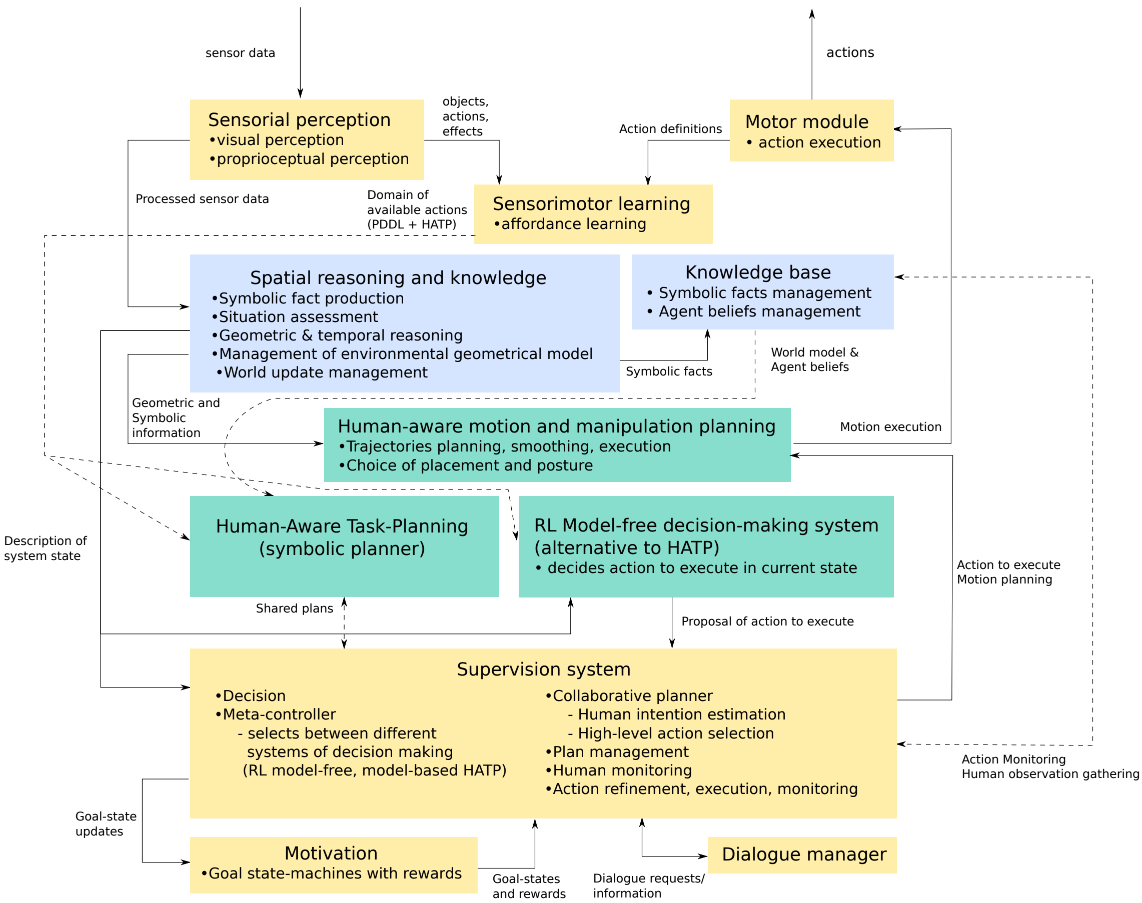

Figure 1: The final architecture design for the RoboErgoSum project. Blue modules are responsible for generating and managing the symbolic knowledge. Decision-making modules are shown in green.

The architecture contains modules for:

- sensing and acting in the environment (Sensorial perception and Motor modules),
- sensori-motor learning (sensori-motor learning module),

- symbolic knowledge generation and management (blue modules: Spatial reasoning and knowledge, Knowledge base)
- decision and action planning (green modules: Human-aware task planning, Reinforcement Learning model-free decision making system, Human-aware motion and manipulation planning),
- controlling the modules (Supervision system),
- managing goals (Motivation module),
- Dialogue management.

Although an integration of all the developed modules into a single system was not achieved due to time and resource constraints, the modules developed by the research groups have been validated in the following combinations:

- Sensorial perception, Motor module, Sensori-motor learning (ISIR),
- Sensorial perception, Motor module, Spatial reasoning and knowledge, Knowledge base, Supervision system, Human-aware task planning, Human-aware motion and manipulation planning, Motivation, Dialogue Manager (LAAS)
- idem (LAAS), plus the Reinforcement-Learning model-free decision making system (ISIR).

Both ISIR and LAAS have developed their own Sensorial perception and Motor modules, motivated by their focus on different parts of the research project.

The interconnections between the modules are structured in the following way. The **Sensorial perception module** contains the innate set of perceptual abilities for perceiving the environment (visual perception and proprioception). The **Motor module** contains the innate set of action primitives available to the robot, which allow it to interact with the environment.

The **Sensori-motor learning** module processes the available pre-processed inputs (i.e. objects detected, actions performed, measured effects) to discover and learn which interactions are available to the robot in the current environment (i.e. affordance learning). It also generates the set of available actions, that were learned after the interaction with the environment, together with their pre-conditions and post-conditions.

The **Spatial reasoning and knowledge** and the **Knowledge base** modules generate and store symbolic data about the perceived environment. This data is then used in the action planning phase by the corresponding modules: **Human-aware task planning module**, and the **Human-aware motion and manipulation planning module**. Knowledge about the current state and the available actions is used by the **Reinforcement Learning model-free decision making system**.

The **Supervision system** communicates with the aforementioned modules to decide which action planning system to employ, to perform on-line plan correction, and to monitor the activity of humans with which it interacts.

The **Motivation** module manages the set of goals that have to be achieved by the robot. Together with the action planning modules, it computes the optimal set of actions to perform, so as to obtain the highest reward in the given time horizon.